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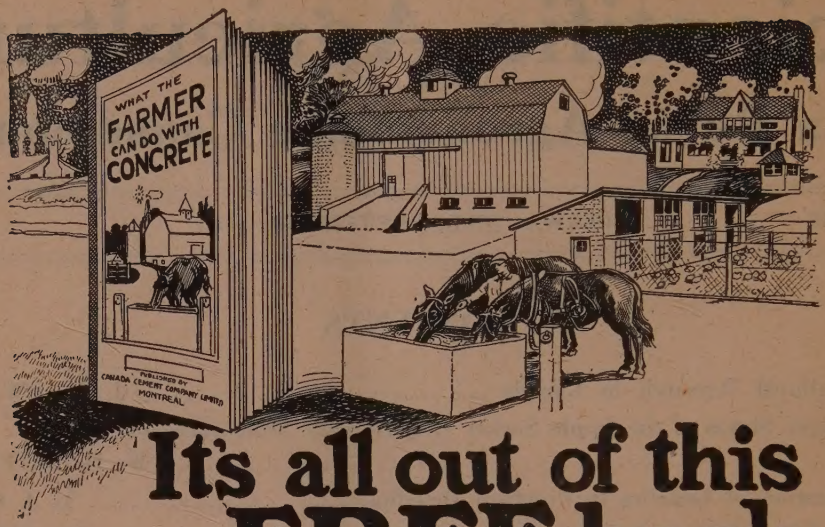

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Editorial

The present issue marks the commencement of a new volume of *Scientific Agriculture* at a new place of publication. For a number of reasons Ottawa would seem to be the logical headquarters of such an Organization as the Canadian Society of Technical Agriculturists. Practically every official of the Dominion Department of Agriculture is a member of the Society and will give full support and co-operation; this is of the greatest importance, since frequent counsel is essential to the proper and efficient conduct of the Society's operations. An official organ is vital to any national body and it is becoming more and more apparent that *Scientific Agriculture* is filling an important niche in professional agriculture. Its scope is likely to widen rapidly as the Society extends its activities. With the headquarters of the Society, and of its official organ, located at Ottawa, developments in a number of directions are to be anticipated.

* * *

One needs only to examine the list of suggested research problems, published in this issue, to appreciate the growing need for trained research workers in agriculture. It is true that a number of the problems listed in the report of the Committee on Research are already in course of investigation. Within a few months it will be possible to announce just how large this number is; it is safe to state now that by far the large majority are as yet uninvestigated.

A study of these problems by qualified workers is urgently needed. Who is to carry on such investigations and where can the work be done? Are there enough trained men available and adequate facilities to meet the situation? To answer these questions is to draw attention to a lamentable state of affairs, but one to which emphasis should be given. Our agricultural colleges have turned out, during the past forty years, several thousand graduates. A few of these men have continued their studies, have received advanced degrees and rank among the specialists who are competent to investigate problems that demand specially trained workers; in their graduate studies and subsequent investigations they have contributed, and continue to contribute, to the field of original research.

Setting aside those who have taken their Master's or Doctor's degree, there is left a surprisingly large number of graduates who have taken no other degree than the B. S. A. A study of the present occupations of these B. S. A. men is interesting. A fairly large proportion have left the field of agricultural teaching and investigation; they have returned to the farm or have entered commercial work, journalism, etc., where specialism in one particular branch of agriculture is not entirely necessary. Of those who are holding positions as instructors or investigators, two main obstacles have prevented the taking of advanced degrees—shortage of funds or the difficulty of securing leave of

absence, or both. These obstacles are almost unsurmountable in the case of the graduate just leaving college with his B. S. A. but perhaps no more so than in the case of many who have been out of college for years. Of the two obstacles shortage of funds is the greater.

Canada needs more agricultural specialists. Many qualified men are ready and anxious to complete a further course of study in order to qualify themselves better for the particular type of work in which they are engaged, or for positions commanding a larger remuneration. They are unable to afford the cost of taking such courses. In the interests of agricultural advancement, particularly in the field of research, something should be done to encourage the taking of advanced degrees in agriculture, by making it easier to take them. The establishment of a number of scholarships, open to anyone holding the B. S. A. degree or its equivalent, would be a tangible step in the right direction and one which might well be taken by the Canadian Society of Technical Agriculturists, since the encouragement of research is one of its stated objects. The results of such a move would be immediate and cumulative. No greater service could be rendered to Canadian agriculture.

* * *

It is considered highly important that more publicity should be given, throughout the year, to the various lines of work being conducted by the C. S. T. A., rather than publish the results once each year at the time of the annual Convention. This would keep the members, and others, closely in touch with a number of important activities in which all would be interested.

The following is a fairly comprehensive list of the work now being carried on by the Society, apart from that of a routine nature:—

1. A study of the educational organization and policies now in effect in Canada, and of the manner in which they may be more closely co-ordinated and standardized. President Klinck of the University of British Columbia, with a committee of eight others, is in charge of this investigation.

2. A more detailed compilation of the number and type of research problems now being investigated in Canada, and of problems that require investigation. Dr. J. F. Snell of Macdonald College is conducting this work, with a committee of eight.

3. An effort to add to the curricula of our agricultural colleges a more complete course in marketing education and in the business aspects of agriculture. Professor A. Leitch of the Ontario Agricultural College is Chairman of a special committee on this work.

4. An enquiry into the facilities for graduate studies in Canada, the courses now being offered at Canadian institutions and the facilities available. This committee is working under the Chairmanship of Professor R. Newton of the University of Alberta.

5. The Bureau of Records, which is now in active operation, is intended to be of service to members of the Society seeking positions and to employing agencies seeking trained men.

6. The Agricultural Text Book Club which will purchase, for members, agricultural text books at a discount of twenty per cent below list prices, postage paid, and will secure similar books for non-members at list prices, postage paid.

7. The publication of *Scientific Agriculture*, which is owned by the Society.

In addition to the foregoing, it is intended to give more space in the magazine to the activities of local branches and of individual members. During the coming winter many meetings will be held in the different provinces of the Dominion, at which important discussions and addresses will take place. These will be of general interest and will be given frequent mention in these columns.

Agricultural Research in Canada

List of Suggested Subjects for Investigation

Prepared by the Committee on Research of the Canadian Society of Technical Agriculturists.

PREFATORY NOTE.

In the years 1920-2 the Committee on Research, under the Chairmanship of Dr. J. M. Swaine, attempted to secure (1) a list of investigations in progress in Canada, (2) a list of suggested researches. By not a few of the members with whom the Committee corresponded the distinction between the two lists was not clearly appreciated. The Committee decided therefore, to publish a single list of researches as its report for 1921-2, and to leave to its successor the task of collecting and collating information as to which of these topics are already under investigation.

In reading the following list of subjects, it should be borne in mind that while some are mere suggestions, many are already under investigation to a greater or less extent.

J. F. SNELL, Chairman for 1922-23.

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Agricultural Engineering.

1. An attempt to find a surfacing material for cattle stalls which has all the good qualities of sand and gravel concrete and which is warmer, drier and less hard.

2. The length of life, reliability and standarization of commercial "prepared roofings".

3. The cost of production and storage of electric current, by means of the gas-engine-driven lighting plant and storage batteries, to be ascertained under farm conditions over a term of at least four years.

4. The effect of muck soils on thin-walled concrete field drainage tile.

Agronomy.

I. GENERAL.

1. The duration of life of the seeds of the various species of weeds when the seeds are embedded in the soil: (a) in relation of moisture conditions; (b) in relation to soil characteristics; (c) how affected by different systems of soil cultivation and crop rotations.

2. Local field experiments directed towards the increase of productivity of British Columbia farms by the use of permanent rotations, cultural methods, commercial fertilizers and improved lay-mixtures.

II. CROPS.

A. General.

3. The testing of foreign varieties, including those resistant to disease, drought, wind, etc., as to their suitability to Canadian conditions and the development of superior strains by cross-breeding and selection.

4. Variety trials with native and introduced varieties for the purpose of obtaining varieties suitable for particular localities; as an example, the determination of the northern limit of corn as a fodder and silage crop and as a substitute for summer fallow.

5. Studies on the most efficient system of recording a crop's field characters, yield and relative worth.

6. A study of methods in variety testing, —size and shape of plot, frequency of repetition, methods of checking and recording, etc.

7. Investigation of the effects of frost (both early and late).

8. Investigation of the cause of frost resistance and winter hardiness.

9. A study of the causes of drought resistance and disease resistance in plants.

10. Studies in the effect of premature cutting on weight and quality of crop.

11. A study of the relationship between the length of the period from flowering to ripening and the whole period from sowing to harvesting.

12. Studies on the distance pollen is carried by the wind to determine the distance required in isolating wind-pollinated plants.

13. Seed testing and breeding at special stations throughout the country.

14. Tests at many different places to determine further the local suitability of varieties and strains tested at the Colleges and Experimental Farms.

15. Establishment of breeding stations in a number of localities, where conditions are such as to render it improbable that the most efficient breeding and selection can be done at the existing breeding stations.

B. Hay and Pasture Crops.

16. Comparison of the commercial grass and clover seeds handled by the seedsmen.

17. The selection and breeding of grasses and clover strains: (a) maturing at different periods; (b) with varying degrees of leafiness for pasture and hay types; (c) resistant to disease (alfalfas and clovers—particularly to mosaic and leaf-spot); (d) with winter resistance.

18. Experiments with alfalfa, brome grasses and other forage crops dealing with the date, rate and method of seeding.

19. The selection of sweet clover with lower coumarin content.

20. A study of methods of cross-pollination of red clover. Methods of close-pollination that seem likely to influence the setting of seed.

21. A cultural experiment with red clover to determine the best rate, depth and method of seeding for hay and seed production, the best nurse crops and the best fall and spring treatment.

22. Germination studies with treated and untreated clover seed of various ages to determine the vitality of seed at various ages and its relative longevity.

23. A study of natural crossing among wild grasses and the potential commercial value of hybrid grasses.

C. Cereals.

24. The breeding and selection of pure line strains of small grains.

a. Isolation of superior strains of spring sown crops for distribution, and to form a basis for hybridization.

b. Selection of hardy strains of winter wheat for Quebec conditions.

c. Hybridization of wheat for desirable field characters and for high yield of good milling qualities.

d. Hybridization of oats for high yielding early varieties, superior quality medium maturing varieties, and strong straw and disease resistance in all.

e. Hybridization of barley for strength of straw and high yield in hulled and hulless barleys; also high yielding barleys with smooth beards.

25. Cultural experiments with small grain crops to determine the best cultural practices: (a) dates of seeding, (b) rates of seeding, (c) drilling vs. broadcasting, (d) grains singly and in combination.

26. Studies in the technique of crossing in cereals.

27. Researches in the natural crossing of cereals.

28. A study of the inheritance of various characters in cereals, such as size, shape and hardness of kernel, colour of flour, earliness, shattering (wheat), number of rows in head (barley), number of kernels in a spikelet, disease resistance and drought resistance, etc.

29. The improvement of methods for treating cereals for the prevention of smut.

30. Studies to obtain a trustworthy method of preparing a standard yeast for uniform bread-making tests.

31. Studies in the effects of storage on wheat, wheat flour, etc.

32. A study of the cause of the dropping of the awns in certain varieties of barley.

33. An investigation to ascertain what factors control lightness in bread.

34. A study of the proportion of hull in varieties of oats and barley, and the relation of percentage of kernel to weight of a measured bushel.

D. Maize.

35. A study of thickness in planting of ensilage corn to determine the yield and quality of crop produced for silage purposes,

with Longfellow and Golden Glow varieties, with determination of the feeding values obtained from the various thickness of planting.

36. A study of North-western Dent corn; selection by ear row test. The development of a standardized strain of fair tonnage and early maturity suitable for a silage corn in the Eastern Townships.

37. Special testing and breeding studies with seed corn at one or two stations in southern Ontario. The co-operation of agricultural graduates engaged in practical farming is suggested.

E. Roots.

38. Cultural experiments with roots to determine which cultural practice will actually give the highest feeding value per acre. The factors concerned are: dates of planting, distance of planting, rates of planting, dates of thinning, distance of thinning, drills vs. flat land. Field characters, actual yield and dry matter yield used as bases of comparison.

39. The development of pure line strains of roots.

a. To supply strains of all the leading root crops which are higher yielders in actual feeding matter.

b. To obviate planting the present chaotic mixtures offered for sale by the seedsmen. The dry matter test and conformity to type are made the basis of selection.

F. Fibre Crops.

40. The production of new sorts of flax for fibre, with the development of suitable methods (microscopic or other) for determining fibre quality and quantity from single plants or from very small bundles.

41. Studies in the effect on the quality of flax fibre of pulling the crop at different dates.

III. SOILS.

42. A comprehensive survey of soil conditions, embracing both physical and chemical characters, of the more important agricultural areas of Canada. A knowledge of the relation of certain plants (plant indicators) to these soils would doubtless be of benefit to agricultural practice.

43. A study of the effect of different depth of tillage on different soil types.

44. A comparative study of barnyard manures and green manures as means of maintaining the fibre content of the soils.

45. A comparison of about ten basic crop rotations, such as: continuous grain; fallow, grain; row crop, grain; row crop, legume, grain; row crop, grain supplemented by a more or less permanent field of mixed grasses and legumes.

46. Experiments with various methods of growing cereals in rows as a substitute for summer fallow.

47. A survey of British Columbia soils with reference to type and lime requirements.

48. A study of drainage conditions in British Columbia with a view to preparing plans for effective and economical drainage of large areas.

49. An investigation of the irrigation possibilities in the interior of British Columbia with a view to the formulation of a broad settlement policy.

50. An investigation of the use of stable manure in British Columbia. The effect of fall, midwinter and spring applications of barnyard manure, ascertained for heavy and light soils, under at least three different conditions of precipitation.

51. Studies to determine which crops are b est adapted to definite soil types.

52. Further study of the determination of the lime requirements of soil and crops.

53. A study of the relationship between the amount of available nitrogen, phosphoric acid and potash in various types of soil, as determined by a standard method, and the amount and kind of fertilizer required for maximum production.

Animal Husbandry

I. NUTRITION.

1. Investigation of the food requirements of young animals, calves and pigs especially with a view to determining specific ration combinations of Canadian feeds. The information available is too largely American and is far from complete for Canadian conditions.

2. Investigation of Canadian farm feed values for fattening purposes.

3. Investigation of the effects of high production in Dairy Cows and the relation-

ship of nutrition to such effects. (In conjunction with Veterinary.)

4. The efficiency of various feeds for butter fat production and the requirements for stated production with different classes of cattle under various systems of feeding.

5. Investigation of the feeding value of peat which is so commonly used as a feed component.

6. A study in the control of the ash contents of feeds in order to develop greater disease resistance and as an aid in the prevention of sterility in dairy cattle and paralysis or crippling of swine.
(In conjunction with Veterinary.)

7. Investigations in commercial requirements in live stock feeding.

8. Investigation of goitre and kindred troubles in live stock from a nutrition standpoint. (In conjunction with Veterinary)

9. A study of Canadian commercial feeding stuffs with a view to determining the digestible nutrition content and feeding values.

10. A study of the impurities in farm grains and roughages with a view to determining their effect on live stock and the losses sustained thereby.

II. BREEDING.

11. Studies in animal breeding. Blood line combinations in Canadian breeding.

III. MARKETS.

12. A study of meat—quality and value.

13. A comprehensive study of packing house problems relating to bacon curing, preservation of meats and the preparation of fats for human consumption. Bacon curing is apparently carried out in this country largely by mechanical process. It is suggested that these problems should be conducted by a chemical department in co-operation with packing houses.

IV. HOUSING.

14. Studies in ventilation and methods of housing various classes of live stock calculated to supply at the very minimum cost, the essentials for growth and development.

V. SURVEY AND ECONOMICS.

15. The engagement of survey work in connection with beef production on the range and a study of the preservation, perpetuation and re-establishment of ranges in some parts of Canada.

16. Studies of the economics of live stock production with different classes of live stock and different combinations of them under various conditions.

17. Investigation regarding the efficiency of draft horses on farms in both the East and West.

Bacteriology

1. Studies in the bacteriology of canned foods.

2. Studies of the bacterial diseases of plants—especially those of potato, Cucurbits and Iris.

3. A study of the distribution of plant diseases by seeds, tubers, bulbs, etc.

4. A study of the ultra-microscopic plant pathogens.

5. A study of mosaic, peach rosette. Are they of bacterial origin ?

6. An investigation of the importance of insect carriers of plant diseases.

7. A study of the virulence of R. radicicola.

Botany

Note. Many problems will come under several heads but no attempt has been made to arrange cross-references. The list is not intended to be exhaustive.

I. BIOCLIMATIC RELATIONSHIPS.

1. Researches into the relation of weather to epiphytotic.

II. ECOLOGY.

2. Distribution of the various species of Larkspur (Delphinium) in Canada; tests to determine what species are poisonous and at what stage in its life-history the plant is most toxic; what animals are most susceptible to poisoning by these plants.

3. The profitable utilization of swampy and marshy land by the cultivation of Peppermint, Cranberry, Wild Rice and other plants.

4. A study of plant succession on alkaline soils.

5. A study of response in plants to environmental conditions, early development and escape from infection (club root, smut, rust).

III. HISTOLOGY, ETC. OF VASCULAR PLANTS (ECONOMIC).

6. The preparation of monographs of individual cultivated plants relative to their normal anatomy; (a) agricultural, including fibre and other economic plants; (b) horticultural, principally fruits, vegetables; (c) forest and shade trees.

IV. PLANT PATHOLOGY.

A. Biology, dispersal, etc., of the pathogen.

7. Studies relative to parasitism of plant pathogens in relation to economic host plants.

8. A study of bacteria in association with plant life (stimulation, inhibition).

9. A study of plant pathogens and their role in animal pathology.

10. Monographic study of diseases conveyed by the seed, including vegetative reproductive organs.

11. Introduction of diseases from foreign countries; dissemination.

Example: Is fire blight conveyed by means of commercial fruit shipments.

12. Researches into overwintering of disease germs.

13. Researches into the organisms associated with mycorrhiza of Canadian plants.

14. The cause of mosaic disease in plants.

15. Dissemination of fungus spores. Vitality of spores, sclerotia, mycelia, etc.

16. Determination of thermal death points of fungus spores and bacteria.

17. Researches into the mode of discharge of fungus spores in relation to spread of disease.

18. A study of the role of animal pathogens on plants.

19. Study of the parasitic and semi-parasitic flowering plants of Canada and their effect on the host.

B. Host resistance, susceptibility, anatomy, etc.

20. Studies in resistance and susceptibility (Immunity).

21. An investigaton of "Streak" of potato.

22. Studies of mosaic of—Raspberry, Red Clover, Alsike Clover, Alfalfa, Violet, Sweet Pea, Field Pea, Bean, Tobacco, Potato, etc.

23. Researches into rusts of Canadian plants and their hosts. (monoecious, dioecious).

24. Studies of pathological anatomy.

Restitution: (a) cells, (b) tissues; hypoplasy (growth inhibition); metaplasy (growth stimulation); hypertrophy (intumescences, tyloses), hyperplasy (homoplasy, heteroplasy).

C. Plant disease survey.

25. A survey of plant diseases in Manitoba.

26. A plant disease survey in Quebec.

D. Descriptive Pathology.

27. A study of Peony diseases.

28. Researches into the nature of root diseases of economic plants.

29. A study of Sclerotinia disease of the cultivated sunflower.

E. Eradication and Control.

30. Investigations in diseases of potatoes.

31. Investigations in diseases of cereals.

32. A study of bean anthracnose in Quebec.

33. An investigation of winter injury of apple.

34. A study of smut control in cereals.

35. Prevention and control of disease by stimulation of host plants.

F. Legislation.

36. Plant pathology and legislation (national-international).

V. PHARMACEUTICAL BOTANY.

37. The possibilities of cultivation in Canada of various medicinal plants and plants used for insecticides.

38. Investigations to determine the poisonous qualities of the Meadow Horsetail *Equisetum pratense* and whether the fruit of Black Nightshade *Solanum nigrum* is at any time poisonous.

VI. PHYSIOLOGY OF DISEASE.

39. A systematic study of functional disorders in economic plants.

a. Effect of soil condition: mechanical, physical, chemical, biological.

b. Effect of prolonged drought and wet, frost, heat and sun, hail, lightning, etc. A systematic study of plants injured by hail, frost, sunburn, etc. seems urgently required.

c. Effect of gases and fumes, smoke, dust, fog.

40. Studies in predisposition of plants towards disease.

41. Studies in deterioration and degeneration.

42. Researches into effect of respiration disturbances in stored fruits and vegetables.

43. Researches into the origin and causes of water core, bitter pit, blossom end rot.

44. Symbiosis versus parasitism of mycorrhiza and root nodules in general.

45. Researches into the vulnerability of plants.

46. Contagion versus infection in plant pathology.

VII. PHYSIOLOGY.

47. Tolerance of seeds of plants towards chemical and hot water treatment. Determination relative to strength of solution, time of their action, etc.

48. Effect of light duration on vitality of spores, etc.

49. Effect of various wave-lengths of light on spores, etc.

50. Effect of soil temperature on disease symptoms, pathological anatomy, etc.

51. Effect of air temperature on disease symptoms, etc.

52. Effect of humidity in relation to air temperature and soil temperature, etc.

VIII. SELECTION AND BREEDING, ETC.

53. The collection of seeds and roots of various wild plants which might be improved by selection and hybridization, and cultural tests of these with reference to hardiness, yield, and other qualities. As examples of the above might be mentioned various species of fruits such as Ribes, Prunus, Rubus, Fragaria and Vaccinium, and plants with edible tubers such as Indian Bread (*Psoralea esculent*) and Indian Potato (*Helianthus subtuberosus*).

54. Cultural and climatic tests of Canadian and other species of willow which might prove useful for making baskets and wicker furniture.

55. Investigation on the feeding value of certain wild plants occurring on the prairie and mountain ranges.

IX. SOIL RELATIONS.

56. A study of soil biology in relation to health of plants (sterility, partial sterility, etc.)

57. Researches into relation of cultural practices to disease.

58. Soil acidity and disease.

X. TAXONOMY AND MORPHOLOGY OF FUNGI.

59. Taxonomic studies of groups of Canadian fungi.

60. Studies of Septorias.

61. Studies concerning the genera Colletotrichum, Volutella, Vermicularia and Gloeosporium.

XI. WEEDS (CONTROL, ETC).

62. The use of certain oil-yielding and fibre crops such as sunflower, castor bean, broom corn, and hemp as a smother crop for weeds.

Chemistry

1. Chemical analysis of soils in connection with soil surveys.

2. A study of soil acidity.

Methods of determination; relative importance of total acidity determination and of determinations of concentration of hydrogen-ion; lime requirements of various types of soil for various crops.

3. A study of the quantity and nature of the soluble salts in alkali soils.

4. A study of the sulphur content of Canadian soils and its relation to productivity.

5. Adaptability of single fertilizers to different soil types.

6. Comparison of nitrogenous fertilizers (such as sal ammoniac, ammonium nitrate, cyanamid, ammo-phos and fish waste) in the greenhouse and field.

7. Effects of acid phosphate and ground limestone in varying proportions on different types of soil.

8. Effect of phosphates (especally acid phosphate and basic slag) on sweet clover.

9. The use of ammoniacal gas liquor as fertilizer and its effect on soil fauna and flora.

10. The effect of vetches and buckwheat in building up humus in red sandstone soil.

11. A study of the composition of cereal fats and of the causes and prevention of rancidity therein.

12. A study of the composition of the sunflower plant at various stages of maturity.

13. The determination of the digestibility of the nutrients in sunflower and maize ensilage.

14. The utilization of waste fruit. The fruit growers of Nova Scotia are giving this question some consideration as far as apples are concerned.

15. The composition, utilization and economic collection of maple sugar sand.

16. An investigation of the flavouring constituent of maple sap.

17. The possible utilization of weed seeds for any purpose other than fuel.

"The dockage fixed by grain inspectors in some years amounts to 150,000 tons, approximately one-half of which is composed of weed seeds and other refuse screenings. These weed seeds have been shown to be rich in oil. Their market value is approxmately on the basis of their value as a fuel."

18. The utilization of waste straw by: (1) conversion into more digestible products and use as feed, (2) conversion into combustible gas and by-products, (3) conversion into manure by fermentation, or (4) otherwise.

19. Further studies on the economical production of effective insecticides and fungicides.

Dairying

1. The determination of standard rations for the feeding of dairy cattle.

2. The determination of standard methods of manufacturing butter, cheese, condensed and powdered milk and ice cream.

3. A study of the composition of milk and its products in Canada.

4. A study of the causes of, and remedies for, bad flavors in dairy products.

5. An investigation into the possible correlation of the grading of cream and butter with the bacterial content of the cream and butter involved respectively.

Having in mind the established causative agencies of many of the troubles met with in the management of milk and in the manufacture of dairy products, it has seemed that the basic principle underlying successful grading might be conceivably a true appreciation of the bacteriological factors concerned therein.

Thus far attention has been devoted principally to butter.

a. Butters submitted to the Grading Competition of the British Columbia Dairymen's Association.

b. Butters submitted to the Dominion Grading Competition.

c. Butters and other material thereto related, which, although originally graded in a high class, subsequently developed undesirable qualities, and were reduced in grade.

The work has resolved itself to a great extent into the securing of the various types of organisms present, and the determining of their relative frequency. This is a necessary preliminary to any attempted correlation such as ultimately it is desired to consumate. There have been secured upwards of 500 organisms in pure culture.

On preliminary cultural tests, a number of duplicates have been eliminated, and the further cultural work proceeds.

"The further the work proceeds, the more are we led to believe that it would be of advantage, if the personnel of other laboratories across the continent could undertake—if they so feel justified—an inquiry of like nature in connection with the grading of butter and cream in the respective provinces."

6. An investigation to determine if possible the "period of usability of milk".

Investigations are being pursued into the length of time which is involved in the clotting of milk and the spoiling of milk and into the varieties of bacteria associated with these changes.

7. A study in the Production of Wensleydale Cheese.

An investigation was commenced in September of 1920, to determine if possible the suitability of certain districts of British Columbia to the manufacture of blue veined cheeses.

8. The treatment of cream for buttermaking.

An investigation including inoculation with *Streptococus lacticus*.

9 An investigation as to the suitability of certain districts of British Columbia for the making of Camembert cheeses.

10. Experimental work with the object of determining the effect of sunflower silage on the quality of butter.

11. Experimental work with the object of determining whether or not the oils in the seeds of the sunflower affect the composition of butterfat. Increasing use of sunflowers as silage renders such a research desirable.

12. Investigations into the relationship of defined feeds to the bacterial flora of bovine faeces, followed by determining the responsibility of such feeds for the presence of bacteria of an undesirable nature in milk by reason of possible manurial contamination. The previous work of Weigmann, Jensen and others is of sufficient note to emphasize the desirability of undertaking such researches. Moreover, there is more than the possibility of an investigation of this nature contributing to the elucidation of some of the problems with which we are confronted in our "Milk Clotting" researches.

13. Experiments with the object of defining the desirability or otherwise of recommending the use of certain types of separators at present on the market.

14. Investigations with the object of determining the effect of the modern procedure in the more advanced creameries throughout the Dominion on the vitamine of butter-fat. It would seem to be of the utmost importance that researches should be conducted in butter manufactured according to the system mentioned immediately above. As such an investigation would require at least the collaboration of the biochemist, the worker on problems of nutrition, the bacteriologist and the practical buttermaker, the difficulties ahead are not of a minor nature. Yet it is to be desired that some means will be devised whereby researches of this nature may be commenced.

Entomology

Studies in Systematic Entomology: The proper identification, description and classification of all insect groups which include species of economic importance is absolutely necessary for the successful development of economic entomology. It is of the greatest importance to have a reliable determination of the insects dealt with, so that the work of previous writers may be available, or, if the species are new to science, to have proper descriptions made so that the records to be taken may be serviceable to future workers. This identification and description often can be made only by a specialist in the group to which the insect belongs. The dissection and detailed study of the parts of insects, both external and internal characters, serve as the basis for classification and for the interpretation of insect habits and adaptions. It should be recognized, therefore, that investigations in the Taxonomy, Morphology, and Nomenclature of Insects, have a real value in the development of Agriculture.

A very large number of these problems could be given; but it will be sufficient for our purpose to name such groups as the Noctuidae, Pyralidae, Cerambycidae, Buprestidae, Chrysomelidae, Siricidae, Tabanidae and Culicidae.

1. Research into the causes of insect outbreaks; to determine all factors concerned, such as food supply, climatic conditions and lack of enemies, and the reasons for and affect of their importance under various conditions; to determine, if possible, the leading factors producing "Cyclic infestations.'

2. A study of factors favourable to the development of great insect out-breaks. A study of all factors fovouring the developments of such infestations as pine and spruce bark-beetle and spruce budworm out-breaks in forest and locust and cut-worm outbreaks in grain-growing areas. To extend over a long period of years, dealing with several important insect pests.

3. Research in Natural Control of Insects: A comprehensive study of all natural pressures which check the rapid propagation of insect species including insufficient food supply, adverse weather conditions, parasitic and predaceous enemies of all kinds, in breeding, and all natural factors which tend towards checking the development of incipient out-breaks and are concerned in the subsidence of existing out-breaks.

The Natural Control of the Fall Webworm.

The Natural Control of the Spruce Budworm.

The Natural Control of the Forest Tent Caterpillar.

The Natural Control of the Larch Sawfly and the possibilities of artificial distribution of parasites.

4. A study of natural control of the more important exotic insects injurious to Canadian Agriculture or Forestry. Two series of studies to be made, one in Canada and one in the native country of the species concerned. This would lead ultimately to the importation of all the parasites and predators that could be of any benefit to Canadian agriculture. As a large proportion of our injurious insects are exotics the benefits from such a study should be both large and permanent.

5. A study of the natural control factors of certain insect pests, usually local in their attack, but which appear to have potentialities for widespread distribution.

6. A study of temperature and moisture conditions in the soil in their relations to insect life; to a depth of two feet below frost line, in a variety of soils and with a variety of drainage conditions, using continuously recording equipment at frequent intervals of depth, particularly near the surface of the ground.

7. The influence of weather conditions on insect activities:

a. To determine the influence on selected insect species of sunlight, temperature and moisture, in controlled experiments; supplemented by a study of the influence of the temperature and moisture content of air and host plant under natural conditions.

b. To determine the influence upon insect activities under natural conditions of such factors as hot and cold summers, warm and cold winters, wet and dry seasons, direct sunlight, excessive heat, excessive cold, ice storms, heavy wind storms and alternate thawing and freezing.

8. The effect of the practice of 'clean culture' about farms and along roadsides upon the insect injuries to crops. This will include a study of the effects of clean culture upon the members of insectivorous birds on extensive, cultivated areas, and with detailed studies of the habits and interrelations of birds and insects.

9. A study of different systems of field crop rotations in their effect upon the numbers of insects of different life-history cycles present in the area involved.

10. A study of the Bioclimatic Law; the relation of latitude and altitude to the periodical phenomena of insects. To determine, by means of phenological data on plants and animals, the normal rate of difference in the beginning and ending of periodical phenomena of insects due to difference in latitude and altitude over local physical conditions. The fact that plant and insect activities are closely correlated has been known and utilized for some time. Dr. A. D. Hopkins, of the Bureau of Entomology, U. S. Department of Agriculture, has been investigating this problem for a number of years, and has shown that plant phenomena can be used as much more reliable indices for the application of insect control measures that can dates.

It appears urgently desirable that certain plant and insect activities should be recorded for each season at a large number of selected stations throughout Canada, and that this data should be carefully analyzed with the view of its utilization in insect control. An important and urgent example of this need is the problem of the Hessian Fly in Western Ontario. A fly-free fall sowing date should be determined for each locality.

11. A study of insect hibernation under various Canadian winter conditions. Methods of hibernation, hibernation devices and their effectiveness, causes of mortality in hibernation.

12. An insect survey in certain selected areas, combined with an Intelligence System through which definite reports upon injurious insects would be received regularly by

a central office from correspondents in a large number of selected localities.

13. Comparative tests of various spraying and dusting schedules for orchards.

14. A study of the effect of lime-sulphur sprays on apple foliage and young fruit; the degree of absorption from the under surface of the leaves, and the effect upon the chlorophyll in the leaf; climate factors influencing results.

15. A study of the effect of poisonous and non-poisonous sprays and dusts upon fruit blossoms and foliage and upon the finish and keeping qualities of the fruit.

16. An investigation of the influence of locusts in range areas together wth the interrelations between insects and stock-grazing in affecting the depletion of the ranges.

17. The relation of insects to the transmission of fire blight in pear and apple trees.

18. The preparation of a floral and faunal zone map for Canada.

19. A study of the maximum and minumum temperature limitations for the different species of insects which prey upon grain and seeds, and an examination of the disadvantages, if any, of storing grain under conditions which may protect insect life against the effect of low temperature.

20. Research into the causes and natural methods of insect distribution; the influence of food supply, atmospheric conditions, inherited habit, and other factors.

21. A study of human agency in insect distribution.

22. A series of studies in the classification and biology of all groups of beneficial insects, parasites and predators.

23. A series of studies in Insect Ecology.

24. Detailed studies in the biology and control of many insect enemies are urgently needed. A few of these problems are listed, many of which are already in progress:

The Biology and Control of the Satin Moth and the Poplar Sawfly in British Columbia; the White-marked Tussock Moth in Eastern Canada; the Carpenter Moth caterpillars of the genus Prionoxystus; the boring arvae of Cerambycidae and Buprestidae in living shade trees; the spruce mite; grasshoppers, cutworms, Psyllia mali; orchard aphids; cabbage maggot; the carrot rust fly; the onion maggot; warble flies, bot flies in horses and all other insects affecting live stock; wireworms (Elateridae); white grubs, (Lachnosterna); the hessian fly; the Oscinidae; the European Corn Borer; the Codling Moth; the apple maggot; the plum curculio.

25. A study of the Ipid bark and timber beetles of North America:

To investigate all problems related to the classification, morphology and biology of the species of the most destructive family of forest insects; with a view to a complete monograph of the North American species.

26. The further investigation and perfection of control measures for destructive and injurious bark and timber beetles of Canadian forests; dealing chiefly with the genera *Dendroctonus, Ips, Polygraphus, Dryocoetus* and *Pityokteines*. A detailed study of the seasonal history and habits of the species, the relation of each species to the health of the affected timber, effect of parasites, predators, climatic conditions, food supply and all other factors influencing the rise and fall of specific outbreaks, the relations of primary and secondary species, with the view of perfecting the most effective measures of control.

27. The classification of the larvae of Ipid bark and timber beetles. The practical application of this study will be to aid in the determination of this class of injuries when the adult beetles are not obtainable.

28. A comprehensive study of the morphology and classification of the larvae of *Cerambycidae, Buprestidae* and other forest Coleoptera, excluding the *Ipidae*. Our most serious forest insect pests are injurious in the larval stages and since the larvae are seldom associated with adults, except with the *Ipidae*, a satisfactory classification of the larvae is essential to the perfection of control measures.

29. General studies in the biology of forest insects:

All preventive or control measures in forest entomology are based on a knowledge of the insects' habits. This can only result from detailed studies of their activities. Frequently it has happened that further investigations bring out unknown details of the habits to which methods of forest man-

agement can be correlated giving more practical methods of prevention or control.

30. Studies in host selection with certain species of wood-boring beetles; an investigation of the possible inheritance of a taste for new host tree species.

31. Permanent forest sample plot studies. To determine the part taken by forest insects in the development of a stand of timber under various conditions. Sample plots, usually one acre in extent, are laid out on selected sites, the trees numbered with tags, described, and a record kept of their condition from year to year. The aim should be to cover eventually all our Canadian timber trees, growing under different type conditions. Excellent opportunity is afforded for the study of specific insect injuries.

32. The influence of bodies of injured and dying trees from slashings, burns or wind-falls upon the endemic insect injury in the neighbourhood. This study is carried out chiefly on temporary sample plots laid out in green timber on the margin of burns and slashings.

33. The influence of bodies of injured and dying trees from slashings, burns or wind-falls, in the development of extensive bark-bettle out-breaks. Further studies and the tabulation of data.

34. A study of the interrelations between insects and forest fires in the destruction of timber. Ground fires kill the timber without destroying much of the bark and the latter serves as a choice breeding ground for bark-beetles and other bark and wood borers. On the other hand, fire-killed trees and slash carrying great numbers of boring insects may be destroyed by fires. Further study and the tabulation of data.

35. A seasonal study of the attack of bark wood boring insects on injured and dying forest trees. Trees of various species are cut or girdled by different methods each month during the year, and the resulting insect attack recorded and studied.

36. A study of the factors which influence the distribution of forest insects from foci of heavy infestations.

37. Investigation of the insect enemies of forest nurseries and forest plantations; seasonal history, habits and control measures, under various nursery and plantation conditions in Canada.

38. Investigation of the life-history, habits and control of the insect enemies of forest reproduction; including those injurious to flowers, developing seed and seed stored in the soil, and to all parts of seedling trees and saplings.

39. An investigation of the Spruce bud-worm injury in Eastern Canada. A comprehensive study of all the factors concerned; the primary spruce bud-worm defoliation, Pissodes injury, Pityokteines injury, fungus injury, effect of previous retardation in inducing borer attack; a complete investigation of the biology of the insects and their relation to the injury; the factors concerned in the rise and fall of the individual outbreaks; the method of distribution over large areas, methods of control or relief to prevent wholesale destruction and future outbreaks.

40. A study of the effects of different degrees of defoliation on conifers correlated with such injuries as that caused by *Chermes* on spruce.

41. A series of studies of the insects affecting each of our Canadian timber trees, such as, the species of pines, spruces, balsams, cedars, Douglas fir, hemlocks, elm, ash, birch and hickory.

42. A comprehensive study of the White Pine Weevil, *Pissodes strobi*, its seasonal history, habits, injuries and possibilities of control under natural conditions and in plantations.

43. An investigation of the seasonal history, habits and control of the Western Cedar Borer in British Columbia.

44. An investigation of the habits and control of pitch moths in pine and spruce.

45. Studies in the biology of the genus *Chermes*.

46. A study of the biology and control of insects affecting stored wood products.

47. Experiments with trap trees in the control of bark-beetles; tests in girdling and felling to determine the most efficient manner and time of cutting and the number of trap trees in relation to the number of beetle trees required for effective control with various destructive species.

48. Studies in the biology of borers in living shade trees, with experiments in control.

49. Experiments with preserving wood against attack by boring insects.

50. The biology and control of mosquitoes of the British Columbia coast region.

51. The biology and control of mosquitoes and black-flies in outlying settlements in Eastern Canada.

52. A series of studies in the biology and control of household insects.

53. A study of plant quarantine in connection with insect control.

54. A series of studies in Medical Entomology.

55. A study of plant quarantine in connection with the control of insect distribution; a history of plant quarantines, their object and the factors determining their effectiveness.

56. A study in insect deterrents and attractants; biochemical aspects, host selection; bee deterrents in arsenical sprays.

57. Insects affecting cultivated crops grown for seed production; injurious insects, pollinators.

58. Investigations relating to greenhouse insects.

59. Investigations relating to live stock insects.

Horticulture

1. Studies in the pollination of tree fruits.

Dorsey in his work of plum pollination has pointed out the vital factor of the rate of pollen tube growth as affecting the set of fruit. Studies along the same lines should be extended to all Canadian fruit districts, and should embrace all tree fruits and all varieties of these which are grown on a commercial scale and should embrace intimate studies of the following features, divided into six distinct problems.

(1) A determination of the self-sterile varieties under different climatic conditions in the field.

(2) A determination and classification of those varieties producing abundant pollen together with approximate relative dates of pollen liberation.

(3) Classification of varieties as to the approximate date of pistil receptivity.

(4) Classification of varieties as to the approximate longevity of pistil receptivity.

(5) Classification of varieties as to the rate of pollen tube growth under field conditions in different localities with varying climatic ranges.

(6) A determination of the affinity of different varieties considering:

a. date of pollen liberation.
b. date of receptivity of pistil,
c. actual affinity.
d. rate of pollen tube growth under varying climatic conditions.

The above should be determined for apples, pears, peaches and plums, and at conclusion of problem specific recommendations should be made to orchardists for planting with a view to eliminating as much as possible risks of non-fertilization.

2. A study of the relation of orchard fertility to the viability of pollen and the setting of the fruit with different varieties.

3. A study in comparison of bloom from varieties which mature their wood early with those which are late in maturing, to determine relationship, if any, between varietal variation in maturation and locality.

4. Investigations with regard to hardiness in trees and other fruits. Recent investigators have established two theories with regard to hardness or resistance to cold and change of temperature.

(1) The concentration of the cell sap including the hydrogen ion determination.

(2) The pentosan content of the plant tissues.

An extension of these investigations should be made on the following lines: A sufficient number of investigations should be made on plants of known degrees of hardiness to validate or otherwise both of the foregoing theories.

If either is found to be of value, an extensive study into the following phases should then be made:

(1) A determination of the established factor for each variety of hardy fruits, which would thus eliminate to a considerable degree the many years of actual testing of much worthless material.

(2) The determination if any cultural conditions could so change the factor as to establish better cultural practice for the severer districts.

5. An investigation of the possibility of maintenance of fertility in market gardens without use of manure.

At present supplies of manure are difficult to obtain even at a comparatively high price. The question of the use of green manures and commercial fertilizers should receive exhaustive study, the following points being considered:

(1) Determination of the relative factor of cost of maintaining fertility by manure and by green manure and commercial fertilizers, considering the extra amount of land required for the latter system.

(2) Determination of above on different types of soil for various market garden crops over a long period of years.

6. A study of soil fertility on irrigated lands in central British Columbia. Very little stock is kept in these sections and the maintenance of soil fertility is becoming increasingly difficult.

7. A study of the influence of direct sunlight and direct solar heat as distinguished from diffused heat on leaves, flowers, fruit of certain cultivated varieties of fruits and vegetables, such as peaches, grapes, tomatoes and melon, and the determination of the optimum ratio of the temperature between root system and top:

a. on their rate of development when grown in the open,

b. on their rate of development when grown under certain exposures such as north, south, east or west.

c. on their rate of development under reflected heat from different coloured back grounds,

d. study of causes underlying increase of rate of growth when grown under glass such as greenhouses, hot-beds or cloches.

e. the effect of relatively low root temperature when top is in relatively high, and vice versa.

8. The production of improved varieties of cross-breeding and selection.

9. Variety trials for the purpose of obtaining varieties suitable for particular localities-

10. Experiments with introduced varieties of plants with the object of determining the possibility of commercial development.

11. A study of native wild fruits for the purpose of determining their value as foundation material in the development of forms for cultivating.

12. A study of the nomenclature and varieties of garden peas.

13. Experiments to determine the comparative value in effectiveness and economy of dusting and spraying for the control of insect and fungous enemies under various climatic conditions.

14. Horticultural surveys from which may be determined costs of production and most suitable methods of growing and harvesting fruit crops.

15. Studies in the production of home grown vegetable seed under various climatic and soil conditons.

Poultry Husbandry

1. A study of the correlation between (a) degree of humidity; (b) circulation of air; (c) temperature; (d) percentage of carbon dioxide; (e) mechanical management; and hatchability.

2. A study of the relation which (a) high production, (b) the dam, and (c) the sire, bear to (a) size, shape and color of eggs, (b) percentage of fertility, (c) percentage of hatchability, (d) mortality in chicks, (e) size of offspring.

3. Studies in poultry nutrition with particular emphasis to protein requirements.

4. A study in sex control in the domestic fowl.

5. A study of the limit in breeding for high production.

6. Studies in inheritance in egg production.

7. A study of relation between (a) mean temperature; (b) variation in temperature, (c) sunshine, (d) humidity, and egg production.

8. A study of the relation between longevity and egg production.

9. A study of the relation that form bears to production.

10. A study of feed consumption in relation to increase in weight in developing chicks and egg production.

11. A study of the comparative rate of growth in the different breeds of poultry in the different provinces, more especially however the difference between the Eastern Provinces, the Prairie provinces, and British Columbia and the causative factors.

12. A study of the influence of electric light on egg production, fertility and hatching in the various breeds.

13. Selection and breeding studies with various breeds.

14. Studies in the cost of production of eggs and poultry meat under different conditions.

Rural Economics and Sociology

Note. A long series of valuable investigations could be suggested in this subject. The "Study Programme" issued by the American Association for Agricultural Legislation covers the field most effectively. Only a few suggestive topics are listed here.

1. Food production in relation to present prices as compared to those of 1913 and 1914. A study of the relations between food production and wholesale and retail prices over a series of years.

2. Problems in Land Settlement. A comparative study of private colonization and Government assistanee in settlement of land.

3. Detailed studies of special marketing problems.

4. A study of taxation in relation to Agriculture.

5. A comprehensive study of Rural Credits.

6. An extensive survey and study of farm labour problems in Eastern Canada, in the Prairie Provinces and in British Columbia.

7. The perfection and extension of an effective cost acount system for farms. Emphasis is laid on the great importance to farmers of keeping a more accurate record, not only of the directly financial end of the business, but of the costs of producing different crops. There is probably nothing that will stimulate farmers to think more and plan their work effectively more than the keeping of cost accounts. The keeping of such accounts will, no doubt, become more general as time passes. The opinion is expressed that something should be done to induce more farmers to take the matter up without further delay. One of the ways in which this might be accomplshed would be to induce more farmers in typical districts to take up the work under the supervision of an authority on the subject so as to supply actual data which might be used as an argument to demonstrate the importance of farmers giving more attention to the matter of costs.

Veterinary Science

1. A study of tuberculosis to ascertain:

(a) The nature of the reactions to various tuberculin tests, with a view to improving their accuracy.

(b) Immunity to tuberculin produced by frequent testing.

(c) Changes in the blood of tuberculous animals, with the object of finding reliable tests for tuberculosis applicable to specimens of serum.

2. An investigation of contagious abortion, to ascertain:

(a) Reliable methods of diagnosis.

(b) Connection between Bang's Bacillus, contagious abortion, sterility, joint ill and white scours.

(c) Different methods of control.

(d) Same problems apply to equines.

3. Investigations of swine diseases, particularly on Haemorrhagic Septicaemia and Swine Plague and their relations to hog cholera.

4. Studies in Swamp Fever of horses to ascertain:

(a) Reliable methods of diagnosis.

(b) Natural modes of infection.

(c) Insect carriers.

5. Studies on parasites of domestic animals to ascertain:

(a) Life-history of parasites where unknown.

(b) Effect of parasitic invasion on health.

(c) Specific allergic reactions.

(d) Methods of control.

6. An investigation of Scabies of cattle, with particular reference to the viability of the parasite apart from its host.

7. Problems in nutrition of fur-bearing animals; nad proper food for specific purposes, such as maintenance of health, increase, quality of fur, etc.

8. Diseases and parasites of fur-bearing animals.

Zoology

1. A series of studies on the relations of birds and certain large animals to agriculture.

2. The biology and habits of the crow in their relation to agriculture in Manitoba.

3. The biology and control of the gopher in Manitoba.

Miscellaneous

1. The recording and analysis of phenological and meteorological data. The suggestion has been received from several sources that a considerable extension of our system of obtaining data of this kind would be desirable. Permanent selected stations and complete -daily or periodic records upon a large number of climatological and phenological data are recommended.

2. A study of methods in co-ordination of agricultural investigation and extension work in the Dominion and Provincial Departments of Agriculture. A comprehensive study made preferably by a small committee.

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The Application of Genetics to Practical Breeding

Synopsis of four lectures at the C. S. T. A. Convention

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I. The Foundations of Genetics.

This lecture consisted of a general review of the fundamental principles of Mendelism and the later developments of the science of genetics. The importance of a unit of inheritance (the *determiner, factor* or *gene*) was stressed, and illustrations were given to show the complex interaction of the genes in producing any individual organism.

II. Genetic Interpretations.

Correlation of chromosome behavior with many cases of normal and abnormal breeding behavior has furnished striking examples of genetic interpretation. This is true for example in relation to linkages, aberrant distribution of characters in heredity (non-disjunction), sterility and partial sterility of hybrids, gynandromorphs, and other phenomena which have previously had no real explanation.

The importance was pointed out of the greater or less physiological necessity of certain genes. In some cases their presence or absence is of little practical importance to the economy of the individual, as, for instance, such a gene as causes the barring pattern in feathers. Other genes are physioligically more fundamental and their absence may lead to physiological deficiency which may merely weaken the constitution of the individual slightly, or may be so serious as to cause its death. Such, for example, are the chlorophyll deficiencies of maize seedlings which are conditional by distinct genetic factors and are definitely inherited in Mendelian fashion. A complete series was pointed out from genes, the absence of which seems negligible, to others so necessary that when they are not present the individual invariably dies at a very early stage in development.

III. Consanguinity: Inbreeding and Outbreeding.

Attempts have been made to define inbreeding as a definite thing; as a matter of fact, inbreeding and outbreeding are relative terms, like heat and cold. Inbreeding involves two things: (1) a reduction in the number of actual individuals in any ancestral generation in relation to the greatest number there might be, and (2) relationship of the parents of the individual concerned,

that is the number of ancestors common to the pedigrees of his sire and dam. Essentially inbreeding tends to "narrow the blood lives," that is, it limits the number of new elements that may be brought in. In this way it tends to produce homogenity and reduces variability. If close inbreeding is practiced, new combinations of the genetic elements in the stock may be made, but no essentially new elements can be brought in; at the same time there is always an opportunity for heritable factors to be lost out, and once gone from the stock they can be replaced only by an outcross to other stock in which they occur. Such losses may be of little importance, or they may produce physiological deficiencies, as previously explained, and may lead to lowered vitality, decreased fecundity, and similar undesirable traits, or even to actual heritable abnormalities. Such results are not invariable, but depend on the nature of the stock at the start and to the selection (either conscious or unconscious) of the breeding individuals after that time. It is obvious that not all individuals raised can be retained for breeding, and the matter of which ones are selected is an extremely important one. This was illustrated by an experiment on inbreeding of Rhode Island Red fowls, where the closest kind of inbreeding was practiced. When selection was based on *color* alone the stock died out in a few generations, owing in large part to progressive decrease in hatchability of the eggs. Since however, selection has been based on strong and vigorous vitality, the stock has maintained itself without appreciable deterioration, even though the inbreeding has been as extreme as before.

IV. What of the Future?

Modern genetics has had a considerable influence in plant and animal breeding in recent years, but has not yet played anything like the part that was predicted for it by some of the early workers. These overly optimistic predictions were made on the basis of the suprising simplicity of the fundamental Mendelian principles and the impossibility at that time of conceiving of the amazing complexity of the interaction of the genetic factors. The mathematics of Mendelian recombinations has emphasized the great advantage in breeding operations of being able to deal with large numbers, and it is the possession of this advantage, together with the possibility of self fertilization, that has made possible the application of genetic principles to plant breeding much more effectively than has yet been possible with animals.

When we think of improvements in breeding methods we are perhaps inclined to have in mind especially the production of new and startling plant and animal types. As a matter of fact, it is probably of greater importance that we should learn how to be able to produce certainly and uniformly as good as the best that we now have. To this end modern genetics is already of much aid, and a knowledge of the subject, furthermore, gives basis for prediction as to what is probably attainable and what not, of how many generations or individuals it may be necessary to raise in order to obtain a desired result, and of short cuts which may give more direct routes to the desired end. An example of this is the prediction of uniform crossbred material from definitely bred stock lines. This method has been most highly specialized by D. F. Jones in his proposed scheme of securing the uniform benefits of "hybrid vigor" in maize by an elaborate method of double crossing of inbred strains. The possibility of segregating special strains by inbreeding and then of producing superior forms by interbreeding certain of these strains, has been further emphasized by the work of Sewall Wright in resistance to tuberculosis in Guinea-pigs, and opens up a wide field for the possibility of some form of the general use of inbreeding in both plants and animals.

These and other breeding methods based on an application of the intricate details of genetic principles can be carried on only by persons thoroughly trained in genetics and to a certain extent also in mathematics, particularly in that part relating to the theory of probabilities. Although as yet the definite applications, such as those indicated above, have not been brought to a practicable stage for use in many instances, it does not seem hazardous to predict that the time will soon come when the science of genetics will play a considerable part in both animal and plant breeding operations.

La Digestibilité des Aliments

Par J. FERLAND.

La digestibilité d'un aliment est la propriété qu'il possède d'être utilisé en plus ou moins grande proportion par l'organisme. Tous les principes alimentaires qui sont ingérés ne sont pas utilisés, autrement dit, ne sont pas digestibles; les uns échappent parce qu'ils se trouvent protégés par des membranes qui ont pu résister aux agents mécaniques et chimiques de la digestion, d'autres parce qu'ils se sont trouvés au milieu d'une masse trop considérable de substances inertes; dans certains cas c'est la machine animale elle-même qui a un fonctionnement défectueux, la cause en étant chronique ou passagère, générale ou individuelle. Le rapport qui existe entre le poids de la substance totale consommée et le poids de nourriture assimilée s'appelle coefficient de digestibilité. Des expériences nombreuses ont été faites pour déterminer ce coefficient. D'après l'analyse préalable des aliments on a calculé le poids des principes nutritifs consommés puis on a recueilli à la sortie du tube digestif les substances inutilisées. Par différence on a obtenu la matière digérée. Les chiffres ainsi trouvés dans différentes expériences ont servis à établir les proportions moyennes dans lesquelles sont utilises les divers principes nutritifs dont se composent les aliments.

Digestibilité des albuminoides.

Les matières protéiques sont enfermées dans les cellules des plantes, environnées par conséquent plus ou moins complètement de membranes et de tissus formés de cellulose. On comprend donc que, dans une large mesure, la digestibilité de ces substances dépend de la facilité plus ou moins grande avec laquelle elles peuvent être attaquées par les sucs digestifs. Par conséquent, plus la digestibilité de la cellulose est élevée et plus celle des albuminoides est augmentée. Voila pourquoi un jeune fourrage a toujours une valeur nutritive plus considérable que le même plus agé dans lequel le tissu lingneux est plus développé. Dans une expérience faite sur deux boeufs nourris avec du foin de trèfle à différentes époques de maturité, Gustave Kuhn a trouvé les chiffres suivants:—Foin de trèfle très jeune, coupé avant l'ouverture des fleurs: 70.8% de la protéine a été digéré.

Même trèfle coupé au début de la floraison: 65% de digestibilité pour la protéine. Lorsque les 2-3 des fleurs ont été desséchées le coefficient de digestibilité a été de 58.7%.

Dans la pratique on doit considérer que le coefficient de digestibilité de la protéine dans une même espèce de fourrage est inversement proportionnel à la quantité de cellulose. Il est à remarquer également que ce coefficient est d'autant plus élevé que l'aliment est plus riche en protéine.

La proportion dans laquelle se trouvent répartis, dans la ration, les divers principes nutritifs, a une grande importance sur la digestibilité de la protéine. Si l'on augmente, en effet, audelà d'une certaine limite la quantité d'hydrocarbonés pour un même poids de matières albuminoides on constate qu'une partie de celle-ci est inutilisée. Il y a lieu de remarquer, cependant, que les suidés ont une puissance digestive toute spéciale pour les hydrocarbonés. Dans leur rationnement on pourra donc sans inconvénient en augmenter la proportion.

D'après les expériences d'alimentation compliées par O'Kellner et Henry, on doit estimer qu'en général, dans les bons fourrages ordinaires et les grains, 60 à 75% et quelquefois jusqu'à 90% de la protéine brute est digérée tandis que pour les pailles, les balles et les produits semblables le coefficient de digestibilité varie généralement de 25 à 40%.

Digestibilité des extratifs non azotés.

Les principes qui sont réunis sous cette dénomination sont d'origine très diverse. Ils comprennent les substances qui sont extraites en traitant la matière sèche des plantes avec des acides faibles et des alcolis, moins la protéine brute, la matière grasse et les cendres.

Bien que ces composés soient analogues au point de vue chimique il convient de distinguer les hydrocarbonés proprement dits qui ont une haute valeur alimentaire et les fibres composées presqu'uniquement de cellulose qui n'ont qu'une très faible valeur nutritive.

Les hydrocarbonés représentent la partie la plus soluble tandis que les fibres comprennent ce qui reste de l'aliment après ébullitions successives dans des acides faibles et des alcalis.

Comme les matières albuminoides, les hydrocarbonés sont d'autant mieux assimilables que la cellulose qui les protège est plus facilement attaquée; ces principes sont d'autant plus digestibles qu'ils sont facilement et complètement transformables en glucose. Pour les uns, comme l'amidon et surtout les sucres, les coefficient de digestibilité est très voisin de 100, tandis que les gommes, par example, ne sont que partiellement digestibles.

Digestibilité de la cellulose.

La digestibilité de la cellulose dépend de l'ancienneté de la partie ligneuse qui est plus ou moins imprégnée de lignine, de résines etc; et aussi de l'état de division des fourrages. Bien que dans la moyenne des aliments il y ait de 25 à 50% de cellulose qui soit digestible, on ne doit pas estimer cette proportion comme étant totalement nutritive; une partie étant dépensée pour la formation des gaz produits par les fermentations qu'elle alimente. Grandeau estime qu'il est toujours plus prudent quand on calcule la valeur alimentaire d'un fourrage, de ne considérer que la moitié de la cellulose digestible comme pouvant produire un effet utile.

L'élévation de la proportion des hydrocarbonés dans la ration produit une action déprimante sur la digestibilité de la cellulose; cette action est beaucoup plus sensible chez les polygastriques que chez les monogastriques. Henneberg a énoncé que la quantité de cellulose digérée est en raison inverse du poids des hydrocarbonés d'autre origine contenus dans la ration. Il s'en suit qu'une ration riche en hydrocarbonés amène la diminution de la digestibilité des matières azotées et grasses.

Digestibilité des graisses.

Le dosage de la matière grasse se fait par l'épuisement du fourrage par l'éther. Ce dissolvant entraine, outre la matière grasse, de la cire, des résines, de la chlorophylle, etc; ces corps étant peu ou pas assimilables, plus leur proportion sera élevée, plus le coefficient de digestibilité de la matière dosée sera diminué. Il est une autre condition qui influe beaucoup sur la digestibilité des corps gras: c'est l'état dans lequel ils se trouvent dans les aliments. Dans les graines de végétaux ou ils sont en fines gouttelettes, très divisées, ils sont facilement absorbables tandis que présentes en masse le travail de digestion est beaucoup plus pénible. La proportion des matières grasses dans la ration semble jouer un rôle favorable sur la digestibilité des autres principes et notamment de la protéine. On semble réunir les conditions les plus favorables lorsqu'on fait varier le rapport adipo-protéique entre $\frac{1}{2}$ et $\frac{1}{2}$. La longeur de conservation des fourrages diminue aussi la digestibilité des graisses qu'ils contiennent. L'âge de la plante influ aussi sur le coefficient de digestibilité. C'est au moment de la floraison que s'est manifesté le maximum de digestibilité de la matière grasse.

D'autres conditions agissent aussi sur la digestibilité des aliments telles sont les influences de l'espèce, de la race et de l'individu. Un grand nombre d'expériences comparatives ont été faites par plusieurs auteurs et notamment par Wolff, pour trouver l'influence de la structure des différents appareils digestifs sur l'assimilation. On a trouvé que la protéine était presqu-également bien digérée par tous les herbivores tandis que les équidés utilisent de 7 à 11% de moins de substances hydrocarbonées que les polygastriques. Cette proportion atteint même 20 à 25% en ce qui concerne les graisses et dépasse ce chiffre pour la cellulose. On a remarqué que les porcs ont une faculté digestive toute particulièrement développée pour les hydrocarbonés et qu'ils utilisent très mal les fourrages grossiers.

Les coefficient de digestibilité varient très peu pour les différentes races, bien que l'effet nutritif ne soit pas toujours le même. L'âge et l'état de développement, l'époque du sevrage, l'individualité influent aussi sur le coefficient de digestibilité et peuvent le faire varier de 2 à 4%, rarement plus. Ce qui influe surtout c'est l'alimentation parcimonieuse du jeune âge qui a pour conséquence un organisme insuffisant; la capacité de digestion est ainsi diminuée d'une façon très sensible.

Nos Connaissances Actuelles sur le Lait

PAR M. LOUIS BOURGOIN,
Ecole Polytechnique, Montréal.

(Suite du numéro d'août)

II. LE LAIT ALIMENT.

Nous savons maintenant de quoi se compose le lait et ce qu'il peut contenir dans la pratique comme éléments anormaux. Nous sommes en mesure d'aborder l'étude de sa valeur alimentaire.

Le lait de femme est le seul aliment naturel complet pour l'enfant. On ne répandra jamais assez cette vérité. In en est ainsi, il ne saurait en être autrement parce que le lait est sécrété pour assurer la vie et la croissance du jeune. Il doit contenir, et il contient, tous les éléments indispensables à notre nutrition. Heureusement le lait de femme a un substitut merveilleux: le lait de vache dont la composition se rapproche de celle du lait de femme et qu'une expérience séculaire a montré capable de remplacer ce dernier sans dommages sérieux. Le lait de vache est lui aussi le seul aliment naturel complet pour l'homme. (14).

Il contient en moyenne :

	Vache	Femme	Valeur Calorifique par gramme	Coefficient pratique d'Atwater
Eau	87.5	87.5%		
Gras	3.7	3.5	9.3	8.45
Lactose	4.8	6.8	4.1	3.88
Caséïine ...	3.2	1.1	4.1	3.88
Albumine ..	0.4	1.0	4.1	3.68
Cendres	7.0	3.0		

C'est-à-dire visiblement de l'eau, de la graisse, du sucre, des matières azotées, des sels minéraux, tous corps que nous considérons comme principes alimentaires. Si on s'en tenait à sa composition quantative, le lait au point de vue valeur en énergie calorifique serait un bien médiocre aliment. Le nombre des calories calculées que peut fournir un litre de lait ingénéré ne serait en effet que de 700, alors que le même poids de pain en donnerait environ 2500 et les pommes de terre 3400. (On compte par 24 hrs. que l'apport energétique doit être par kilogramme de poids du corps: au repos 32 à 34 calories travail modéré 35 à 40—forcé 40 à 50—c'est-à-dire pour l'homme moyen 2500 à 3000 calories.) Il y a autre chose à considérer que l'énergie calorifique des aliments; nous avons appris cela voilà seulement quelques années. Des points obscures viennent d'être éclaircis par la physiologie et la chimie alimentaire: le rôle des acids animés (15) dans l'utilization de l'azote alimentaire, l'acquisition da la notion des vitamines (16).

C'est maintenant le problème de la *qualité* que de la quantité qui est la préoccupation dominante des physiologistes. La qualité d'une substance dans une ration est, au point de vue pratique, le complément indispensable qui peut assurer la bonne nutrition d'un organisme. C'est un peu, comme nous le verrons, un retour à la simple nature dont on s'écartait au nom de la science, avec les aliments nettoyés, purifiés, stérilisés, alambiqués, améliorés etc. Seulement la science n'est pas responsable de cette méprise, mais bien le jugement trop absolu des hommes qui, de bonne foi je l'avoue, l'ont interprétée.

L'étude de la chimie des albuminoides a permis de comprendre mieux la structure de ces gros édifices moléculaires auquels il était difficile de toucher sans les culbuter. Ils sont composés de molécules plus simples tels que les acides aminés que mettent en liberté les ferments digestifs et auquels on accorde maintenant le principal rôle dans la réparation des usures cellulaires en azote. S'il n'y a pas identité entre les corps azotés d'origine animale et végétale, au moins contiennent-ils tous des acides aminés qu'on peut considérer comme la clé de voute des édifices protéique. Les principaux sont, à notre point de vue alimentaire: la lysine, la tryptophane, l'histidine, l'arginine.

(14) Edna L. Ferry: La valeur alimentaire du lait, 38ième Rapport, The Connecticut Dairymen's Association: New Haven 1919.

(15) Amines: composés ammoniacaux; acides animés combinaison d'ammonia que avec l'acide monochloroacétique.

(16) R. Lecocq: Les nouvelles théories alimentaires (Paris 1920)

Ces substances, particulièrement la lysine, sont indispensables à la bonne croissance, ce sont elles qui forment les cellules vivantes neuves et empêchent le délabrement de nos tissus. Des expériences nous ont éclairés à ce sujet et il se trouve que la lactalbumine du lait est la substance la plus riche en lysine que nous connaissons.

D'autres corps animés sont présents dans les albumines du lait. Leur nécessité n'est pas clairement établie, du moins pouvons-nous attendre à la connaître un jour.

La notion de vitamine (17) ou substances accessoires de la nutrition s'est introduite dans la science après les études faites sur les petits animaux nourris au riz décortiqué dans le but de découvrir la cause du Beribéri,, maladie touchant surtout les populations nourries trop exclusivement de céréales.

Les vitamines sont des substances de nature chimique indéterminée, nous les connaissons surtout par leurs effets dans un régime où elles sont absentes. Elles se présentent à nous sous l'aspect d'un élément A soluble dans les graisses (*Fat soluble* A) d'un élément B soluble dans l'eau (*Water soluble B*) et un autre dit antiscorbutique qui pourrait bien être identique au précédent. La suppression de l'un ou l'autre des ces éléments dans une ration ne tarde pas à entraîner des troubles notables pouvant aller jusqu'à la paralysie et à la mort.

On ne peut donc pas donner le titre d'aliment complet aujourd'hui à un corps qui ne contiendrait pas de vitamines. Or le lait se classe encore en première ligne quant à l'élément A soluble dans les graisses et renferme une importante quantité d'élément B. Et l'on peut dire qu'il est possible, et l'expérience l'a depuis longtemps prouvé, d'assurer sans aucun trouble la croissance et la nutrition de l'homme par l'usage exclusif du lait.

Un aliment qui contient les vitamines A et B est regardé maintenant comme aliment de protection assurant le renforcement de l'organisme contre les attaques des maladies. On commence même à réclamer le contrôle de "la teneur en vitamines des aliments servis aux vaches laitières" (18), source de vitamines du lait, parce que de plus la valeur du lait dépend de ces substances.

Les éléments minéraux du lait ne sont pas sans avoir leur importance. Raulin, puis des auteurs plus modernes (G. Bertrand) ont montré en effet l'influence sur la vie des traces de corps minéraux.. Le citrate de calcium et les phosphates du lait sont en quantité respectable, d'autres corps faiblement représentés ne doivent pas être négligés: il semble même que leur faible quantité soit un facteur important pour leur bonne assimilation. Seul le fer est peu abondant, mais on sait que l'organisme du jeune en contient assez à le naissance pour n'avoir pas à souffrir de ce que nous croyons être un oubli de la nature.

La valeur alimentaire du lait est encore rehaussée par sa grande digestibilité. Il atténue les mauvaises fermentation intestinales, il fournit le minimum de déchets et partant ne fatique pas les organes excréteurs. Le lait de femme a, pour nous, une digestibilité plus grande que le lait de vache, la chaleur modifie pour ce dernier la marche de la digestion. On sait que le lait subit deux digestions: la digestion gastrique qui n'est terminée qu'après sept heures et la digestion intestinale qui achève la première et la complète. Cette dernière, pour le lait, se montre la plus économique qui soit pour assurer l'assimilation des éléments nutritifs.

Malgré tout ces avantages, et ils sont nombreux, le lait, particulièrement celui de vache, peut causer dans l'alimentation de la première enfance surtout, des accidents quelquefois mortels connus sous le nom d'anaphylaxie lactée.

(à suivre)

(17) Lambling: Précis de Biochimie, Paris 1920. Mac Collum: The newer knowledge of nutrition. Bulletin Institut Pasteur (1914 No. 1 et 2) Bulletin de la Société d'Hygiene alimentaire (1918-19-20-21.) E. Weill et Mouriguand: L'alimentation et les maladies par carence (Actualités médicales 1919) Mac Collum et autres: American Journal of Physiology—Journal of Biological Chemistry. 1914 à 1921. P. Portier: Essai sur la nature des vitamines. Bul. Soc. Hygiène Alimentaire No. 9, 1920.

(18) A. Lery: Les théories nouvelles de l'Alimentation. Bul. Soc. d'Hygiène alimentaire, No. 2, 1920.

The Present Distribution and Economic Status of the Apple Sucker (*Psyllia mali Schmidberger*)

BY W. H. BRITTAIN,

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In considering what restrictive measures should be adopted towards any newly imported pest, it is highly desirable to have as complete and definite information as possible regarding the economic status of the insect within its former range. Such information has been collected by the writer during the past two years and some of the more important details are here presented.

Host Plants

Schmidberger (1840) mentions the insect only as an apple pest and gives no other host plant and Theobald (1909) who has written extensively regarding the insect, states definitely that the apple is, so far as known, the sole host. Other writers, however, have mentioned other plants as being also hosts of the insect. It is difficult to determine, in many cases, whether the writer really found the insect breeding upon the plant designated as a host, or whether the record arose from the fact that the adult insects had temporarily sought shelter thereon. It seems probable that the latter must be the case in many instances, for we have frequently found the insect in considerable numbers on birch, spruce, maple, elm and other native trees in pastures or waste land sometimes quite remote from orchards. It is also quite possible that other species have been confused with *Psyllia mali.*

Kaltenbach (1874) says that it is found in isolated cases on White Thorn. Reuter (1876) reports it is abundant everywhere on *Ulmus*, *Sorbus*, *Pyrus* and *Corylus*. Later (1881) he states that this species is found only upon apple and rowan (*Sorbus aucuparia*) and that the species found on elm is *Psylla ulmi.* Flor (1861b) states that it is found on elm, apple, pear, *Sorbus aucuparia* and *Corylus avellanus.* Sule (1909) records it from the apple and oak and later (1917) states that it lives on apples, hawthorn and service berry. Harrison (1915) records it from the crab apple. Schφyen (1916) states that hawthorn hedges near infested orchards were heavily infested. Tullgren (1917) and Lundblad (1920) mention the rowan, i.e. mountain ash (*Sorbus aucuparia*) as a host. Jablonowki (in litt.) states that in Hungary it is more abundant on wild apple (*Malus silvestris* Mill.), even more abundant than on the cultivated species.

In addition to the apple we have found that, in heavily infested orchards the insect will deposit its eggs on the pear and that these eggs hatch and come to maturity on that plant, though it is evident that it prefers the apple. The same is true to a certain extent of the quince, but on this host the insect was only of rare occurrence. A few eggs were found after careful search upon the plum and one specimen was carried through to maturity upon this plant, though all subsequent attempts to repeat this experiment failed. It seems very doubtful, therefore, that this plant should be considered a true host.

In confinement the insect oviposited only sparingly upon the pear, though depositing its eggs quite freely upon apple. Extensive infection experiments upon a long list of deciduous trees and shrubs gave negative results. On some of them the insect maintained itself for a few days, but eventually succumbed. On the apple, however, the insect can be reared to maturity without difficulty.

Distribution.

Aulmann (1913) gives the distribution of the insect as Austria, Caucasus, Bohemia, England, France, Germany, Ireland, Japan, Central Russia, Middle Russia (including Poland and the Balkan states) and Sweden, and to these Holland, Norway (1916) Denmark (1919) and Nova Scotia (1919) should be added. It is not possible for us, from the meagre accounts available, to trace the history of the insect in each of the countries

where it is now known to be distributed. In England, from which country it is believed that the pest was introduced into Novo Scotia, Miss Ormerod, writing in 1891, states that it was then a well-known British insect, that there existed no published account of its occurence or injuriousness, though the "Gardener's Chronicle" from 1841-1891, was searched for references. Subsequent to this date, however, several British entomologists have written more or less extensively regarding the pest and its control.

Though widespread in Europe, no report of the finding of the insect in North America was made until 1919, when its discovery in Nova Scotia was reported by the writer (1919) The distribution and spread of the insect points to the town of Wolfville as the probable distributing point from which the insect obtained its present distribution in the province. It would naturally be impossible to establish this fact at the present time. Nevertheless, it is significant that the outbreak is by far the most severe at this point and the greatest spread has taken place in the direction that would be expected if influenced by the prevailing winds. In 1920 inspection revealed the fact that the infestation was continuous from Wolfville eastward to Windsor and beyond. On the Hants County shore of the Basin of Minas, the infestation, which then extended as far as Minasville, may have been continuous with the foregoing or it might easily have been brought about by adults blown over from the more or less heavily infested territory on the Kings County side. A glance at a map of the province will also show how the Cumberland County infestation which in 1920 extended from Parrsboro to Bass River might readily have taken place in a similar manner. Westward from Wolfville the infestation extended a short distance beyond the town of Kentville, southward to New Ross in Lunenburg County and northward to Hall's Harbour on the Bay of Fundy shore.

In 1921 the infestation had only spread a distance of four or five miles further west to Waterville on the Dominion Atlantic Railway in the heavily orcharded territory, whereas it was found southward as far as Bedford in Halifax County and eastward to South Maitland on the Dominion Atlantic Railway and north to Maitland on the shore of the Basin. On the north shore of Minas Basin the infestation was found to extend from Spencer's Island on the west to Glenholm on the east, all this being in sparsely orcharded territory.

In 1922 the insect had spread furthest west along the comparatively little travelled Dalhousie Road, at a point midway between Dale and East Dalhousie, far south of any important orchard territory. This infestation doubtless represents a westward spread of the New Ross outbreak and not a direct southerly spread. The New Ross road was found to be infested from end to end and from the southern extremity of this road the insect had spread westward as far as Mahone Bay and eastward to Halifax. On the east the insect was found to be present three miles beyond Bedford and south from Bedford to Halifax. It was also found at Shubenacadie, from which point it had spread to Stewiacke. It had crossed the Shubenacadie River at Maitland and spread from Black Rock eastward as far as Old Barns, near Truro. On the north shore of Minas Basin there was further local spread. North of Parrsboro the insect was discovered as far as Lake Road Corner, while on the east it was found to have spread from Glenholm to Masstown.

In the centre of the Valley it was found about a mile south-west of Aylesford and on the Bay of Fundy shore near Ogilvie.

While part of this spread may be more apparent than real, owing to the great difficulty of detecting incipient outbreaks, it seems evident that the eastward extension of the pest is taking place more rapidly, doubtless due to the fact that the prevailing wind is from the south-west. The only inhibiting factor to its even more rapid spread in this direction is the lack of continuity of the orchards in that territory, which are often separated by considerable distances and by belts of woods. In addition to this they are fewer in number and consist, for the most part, of small plantings.

It is known that in the past, much English nursery stock has been imported into the Wolfville district. This importation ceased, it is true, some fifteen or more years ago, but the extent of the infestaion would seem

to indicate that it could not have reached its present proportions in much less time than this. That it so long escaped detection is not so surprising as would at first appear, since, only when present in enormous numbers are the insects at all conspicuous and then it is more the *result of their work* rather than the insects themselves that compel attention. Except in heavily infested orchards, the insect is very difficult to detect, the flattened form of its body enabling it to penetrate deeply into the axils of leaves and between the flower stalks, where they remain securely hidden from view. It is often only the presence of the tell-tale drop of whitish secretion that reveals their presence and renders possible the satisfactory inspection of thinly infested areas. There is good reason to believe, however, that though the insect has been present for a number of years, the present outbreak represents a sudden increase in numbers. This is borne out by the fact that in many orchards where in one season the insect could only be detected with difficulty or could not be found at all, it was abundant the following year. Furthermore, in 1919 we first received reports from fruitgrowers who had noticed the copious drops of sticky secretion dripping from the trees. Had the same thing occurred in previous seasons, such a conspicuous sign of the insects' presence in large numbers could scarcely have failed to attract notice and excite comment.

Further confirmation of this opinion is found in the condition existing during the season 1921. A very great increase in numbers was noticed in many situations. For example, at Starr's Point the insects could scarcely be detected in 1919. In 1920 they were more easy to find, but still far from plentiful. The following year, however, they were present in such enormous numbers in these orchards that their sticky secretion dripped from the trees during cultivaton, covering the backs of the horses and the clothing of the teamsters when the orchard was cultivated. In many other places the insect was present in abundance, where the previous year inspection indicated only a very light infestation. In 1922 it is just as abundant in many places outside of Wolfville as it was when first detected at that place.

It seems likely that, having attained its present abundance, the insect will spread much more rapidly than when less numerous and it will doubtless be found over an increasingly wide range from year to year. For this reason, no map of the infested area can be regarded as permanent.

Seriousness of Pest.

Schmidberger (1840) in his original accounts of the work of this insect did not appear to regard it as a particularly serious enemy of the apple, but many recent European writers seem to consider the pest as one of the most injurious, if not the most injurious. It was doubtless long known as an orchard enemy before published accounts of its injuries began to find their way into the literature of economic entomology, for no good account of the insect's work appears to have been made until long after Schmidberger's (l.c.) account was published. According to Kaltenbach (1874), the insects are very numerous and affected blossoms often drop to the ground. Schøyen (1896), states that in Vestland and in the Kristiania district, it sometimes causes havoc by sucking the juices from the blossom pedicels, causing them to wither and die, and causes much annual loss. Later (1916) he states that it is the most serious pest of the apple. The writings of Miss Ormerod (1891-1901), indicate that she considered the insect a serious apple pest. Theobald (1906) in his "Report on the Orchard and Fruit Plantations of Worcestershire" refers to the insect as the worst apple pest, destroying fully 70 per cent of the crop of Worcestershire. In his "Insect Pests of Fruit", the same writer says of this insect, "Of all apple pests this is one of the most troublesome". Collinge (1905) speaks of it as being troublesome in the Midland counties. Furley (1907) regards it as the worst pest with which the growers of Worcestershire have to deal. Carpenter (1913) reports great damage to apple blossoms in the year 1912 in the counties of Dublin, Kerry, Armagh and Tyrone in Ireland. Tullgren (1917) and Lundblad (1920) states that it is an injurious pest in southern Sweden. In Russia, judging from the great frequency with which the name of this insect occurs in the writings of entomological workers, it is evidently considered a

pest of the first magnitude. Shreiner (1906) refers to it as being abundant and destructive in the Petrograd district. Portchinsky (1913) states that it is abundant and destructive in North and Middle Russia.

Averin (1913) describes it as a serious scourge in some districts. Zacharievskaji (1915) reports serious injury in the Mararievsk district of the government of Niznii-Novgorod, while records of similar injuries from various parts of the country are numerous. Ferdinandsen (1919) reports it as a serious pest in Denmark. Soraeur (1913) refers to it as a serious, but often scarcely noticed, pest of apple trees in Germany.

The weight of evidence from European sources, while not being in complete agreement as to the seriousness of the pest, indicates that it is a very persistent one and varies little in severity from year to year, owing to the scarcity of important natural enemies and to its resistance to unfavorable weather conditions.

In addition to the foregoing statements, which have been selected as typical for the countries concerned, direct inquiries have been made of some of the leading economic entomologists in countries where the insect is known to occur, with the object of obtaining their views as to the present status of the pest in such countries.

Dr. Paul Marchal, Directeur de la Station Entomologique de Paris, writes that he cannot secure any information regarding the presence of *Psyllia mali* in France. He states however, that psyllids occur in very great numbers upon the fruit trees, and that while these have not as yet been studied, he will be surprised if *Psyllia mali* is not found among them.

Professor Satoru Kuwayama, Hakkaido Agricultural Experiment Station, Sapporo, Japan, states that in Japan three species of jumping plant lice have been recorded heretofore from the apple. First, there is *P. malivorella matsumara*, distributed only in the Nagano Prefecture of the mainland (Honshu), which is considered one of the most injurious insects in that district. There is also *Aphalara nebulosa* Zett., but there is some doubt that this really attacks apple. Lastly, there is *P. mali* Schmidb, recorded by Shigoru Kuwayama (1907) from four specimens captured at Sapporo, but from that time to this no one has been able to discover any damage caused by the insect.

Through the kindness of Mr. L. S. McLaine, Chief, Division of Foreign Insect Pests Suppression, Department of Agriculture, Ottawa, Canada, the writer has been able to obtain information from the following, viz.,

Mr. H. V. Taylor, Commissioner of Horticulture, Ministry of Agriculture and Fisheries in England. Mr. Taylor does not regard the apple sucker as a serious pest and states that one of the capsids is much more injurious to the apple. Mr. Fryer likewise considered that the insect was not a serious pest and stated that a great many of the eggs do not hatch under normal conditions.

Dr. H. Maarschalk of the Pathological Laboratory, Wageningen, Holland, states that it is not prevalent in Holland, but that where it occurs it is readily controlled by spraying the trees with a certain kind of carbolineum.

Dr. L. Reh (Das Zoologische Staatsinstitut und Zoologische Museum, Germany) states that the pest is quite common all over Germany and that it is very injurious. It has not, however, received much attention and even when its seriousness is appreciated, active measures are rarely taken against it, owing partly to the lack of suitable spraying apparatus. Nymphs and adults are difficult to control by sprays and the treatment of the eggs with carbolineum or with caustic washes is rather favored.

Dr. Max Hollrung of Halle states that the insect has not, up to the present, done any considerable harm in Germany. On the other hand it has crossed over into Finland, Sweden, Norway and England in large numbers. Presumably a cooler climate and a higher relative humidity favor their development. In Germany its place is taken by *Psylla pirisuga*. It is further stated that a fundamental knowledge of the biology of *Psyllia mali* is obtained from Schmidberger's small but significant treatise.

Dr. J. Jablonowski, General Director of the Agricultural Experiment Stations of

Hungary, writes that the present status of the apple sucker in Hungary, (i.e. old Hungary) is the same as described by Schmidberger for Austria. It is present everywhere on the apple trees, but the damage done is unimportant, and there is never any necessity of adopting repressive measures. In well treated orchards it is never of any significance. He states further that the insect breeds in incredible multitudes on isolated wild apple trees (*Malus silvestris* Mill.) growing in waste places, the foliage of which becomes whitish, yellowish and marbelled as a result of their work, while all the surroundings of infested trees, i.e. bushes and other species of trees, will be covered by the adult suckers. He emphasizes the fact that in wooded areas and in sections with a cooler, moister climate, the suckers will be commoner than in the dry lowlands of Hungary where the autumn is very adverse.

Dr. Ludwig Sitowski, Posen, writes that in Poland this insect occurs as a pest in great numbers only in the Lublin District near the Vistula. As a remedy, the use of a naptha (petroleum) emulsion is recommended.

From Denmark, Prof. Mathias Thomsen, Lecturer in Agricultural Zoology, Royal Veterinary and Agricultural College, writes that the insect is generally distributed and sometimes does great damage to apple trees. In 1920 the young appeared the middle of April and on May 30th many adults were present. Spraying with nicotine sulphate against young and adults is practiced, but, if possible, the application should be made before the young nymphs enter the buds. Carbolineum (Swedish carbolineum called "Defensolat" or German carbolineum) some ten days or a week before hatching destroys a large proportion of the eggs.

We are not prepared to state at present the exact place that the apple sucker will eventually occupy as an orchard pest in Nova Scotia. The opinion among fruit growers, whose orchards are infested, varies widely, some contending that they do no harm whatever, while others declare that they have destroyed almost the entire crop.

Direct evidence on the point has heretofore been very difficult to obtain, owing to the mixed character of badly infested orchards. With the spread and increase of the pest over a wider area, more concrete results may be expected. It seems certain, however, from our present observations that, insect for insect, the apple sucker is very much less injurious than the green apple bug (*Lygus communis* Knight). Its punctures do not seem to have the apparent "poisoning" effect that seems to result from those of the latter insect. The injury that does occur seems to be due entirely to the loss of sap occasioned by the feeding of the insect. Experiments are now under way to determine quantitatively the effect of the punctures of definite numbers of insects in reducing leaf area, in producing defoliation and in destroying blossoms, also to show the decrease in yield, brought about under actual orchard conditions. At present such information is not available.

Our observations, to date, however, do indicate that light infestations, provided there is a good blossom, do not appear to greatly affect the current season's crop. Even where the insects are comparatively numerous it is often difficult to estimate actual damage. With only a light or moderate bloom, it is easy enough to appreciate the injury caused and in the most severe cases, the destruction of blossoms and leaves is quite apparent.

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The High Cost of Bacteria (*)

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Between sixty and seventy years ago Pasteur was pursuing his first researches into the processes of fermentation, and founding the science of Bacteriology. Of these researches one of the first was the study of the lactic acid fermentation. A few years later, the spoiling of the red and white wines of Jura was presenting a critical problem to the grape growers of France. Pasteur defined the cause as micro-organisms, and provided the remedy. The grape growers were paying for the micro-organisms in loss of money, loss of prestige and losses on account of a diminution in exportation. In due course the methods of control devised by Pasteur were adopted as a national measure. The wonderful researches of the French savant, in rapid succession, constitute one of the greatest chapters of romance in history. Lister, the father of antiseptic surgery, removed the terrors from the surgical operation, and lowered the cost which humanity had been paying for bacteria for ages.

To-day, many of our industries are recognized as being distinctly fermentation industries; and dairying, the one with which we are primarily concerned, is a fermentation industry in the most specific sense—an industry dependent upon the successful management of micro-organic life, principally the bacteria. With respect to milk for consumption as such, and milk from which the various milk products are to be manufactured, the same thesis is sound. Lack of success in the management of bacterial life is responsible for deterioration, wastage, and spoilage; and the nature of our loss, and the amount of our loss—loss of reputation, food, business and cash in dollars and cents—constitute what we pay for our bacteria—and the cost is high.

At this point the data presented in the early part of the paper recently published in Scientific Agriculture on "The Spoiling of Milk", by Wilfrid Sadler and Marion J. Mounce, was used, with certain amendments.

During the last decade or so dramatic researches have been carried out by Funk Hopkins at Cambridge, Starling of London, McCollum of John Hopkins and others, showing in an indisputable manner the unique position held by milk as a food on account of the presence of vitamins, growth-promot-

*—An address (in part) delivered before the Pacific North-West Milk Convention.

ing-factors or accessory-food factors. Thus the spoilage or wastage of milk due to the ravages of bacteria is to be considered in the light of lessening the availability of the vitamins, and of limiting the "period of usability" of milk.

Are these bacteria indigenous to milk? There is a certain amount of bacterial contamination from the udder of the healthy cow, but this source is of minor nature compared with the contamination from external sources. Hence, it is legitimate to state that in the main, bacterial contamination, with the qualification noted, is preventable. It has been found by many workers during the last twenty-five years that, with adequate precautions, milk can be produced containing not more than a few thousand bacteria per cc. Some workers, observing the necessary precautions, have secured milk in practice, containing not more than 4,000 bacteria per cc; and as we all know, certified milk, by virtue of the name defined, must contain not more than 10,000 bacteria per cc. in the summer at time of sale.

The greatest sources of external bacterial contamination are the initial contamination on the farm, and utensils—the latter possibly in many cases the greatest source. With these are the very important contributory influences of age, prevailing temperature, and time occupied in transportation; in other words, taking for granted that the cows are healthy, contamination results from mis-management or lack of management in all pertaining to the sources of and the activities of bacteria. Would it not seem feasible and legitimate to suggest that spoilage which is preventable is a misdemeanour? By all means let us have adequate inspection, filtration, pasteurization and all the other safe-guards; but our problem will not be solved till we get to the bottom of the whole question, the bacterial content of the milk and its elimination. Milk will not keep indefinitely. It cannot be used forever. But we must insure its "maximum period of usability", and if we can define such our practices must be improved accordingly. Think of the prestige involved. Can an all important critical product be allowed to spoil before it should? Think of the lack of guarantee, the loss of food and the enormous loss of money caused by a limited "period of usability." For is not "period of usability"., retaining of quality, a prime desideratum in all commodities? For some three years in my Departmnet we have been carrying out 'clotting tests' with a view to securing data as to the 'period of usability' of milk. The available data are not sufficient for us to base definite conclusions upon at present; but there are indications as to the direction in which tentative suggestions can be projected. We have worked at four centres; and thus far we find that in some cases, milk will clot in from one-quarter to one-half the time it required in other cases. Is it just or even fair that the man who produces the milk which will clot, at any rate twice as quickly as the milk produced by another man, should be paid the same price per pound of butterfat? Does it not seem reasonable to place a cash value on bacterial content? One of my associates, Miss M. J. Mounce, is still engaged on this phase of the work, and in due course we have reason to believe that we shall have data providing us with the basis for definite advice. Obviously, milk is not usable up to the time it clots; but the phenomenon of clotting is readily seen and recorded, and thus far it provides us with a means of defining the comparative 'period of usability' of various milks.

How are we to bring about a lengthened "period of usability' of milk, and thereby avoid the degree of spoilage that has been indicated? There would seem to be at least four essentials:— 1. the elimination of bacteria; 2. the education of producer, distributor and consumer; 3. exhortation— and it would seem that to a great extent this should involve reasonable and definite financial inducements; 4. legislation— regulations based on the feasible practical application of approved scientific findings.

We have said that the udder flora is comparatively small. The initial contamination on the farm may include bacteria from manure, and from dust. The initial contamination referred to can be lessened and largely eliminated with intelligent care. The bacterial effect from utensils can only be eliminated by the most scrupulous cleansing, and the adequate use for a sufficient length of time of live steam; and it is not

too much to state that a large percentage of the spoilage of milk and the subsequent loss in money and food can be traced to the lack of copious boiling water and an adequate amount of live steam. This brings us to the most important factor in the whole business—the man or woman on the job. It would seem a simple matter to say wash your utensils, and subject them to live steam, but in order to do this satisfactorily, just as must be done by a hospital in controlling the preparation of the surgical instruments, the man on the job must have an appreciation of the factors with which he is working. In other words, he needs to have the bacteriological eye. While satisfactory buildings and good equipment are of essential assistance in the procuring of a satisfactory milk, the personnel is of more importance still. And it is to the personnel with the bacteriological eye that we must look for our diminution of rate, and diminution of extent of spoilage in milk; and for the insuring of a milk with a longer 'period of usability. I will not weary you with long citations of figures which are the results of scientific investigations. The literature is replete with them; and if you will consult the work of those on the Continent of Europe, in the Old Country and in the United States of America, and in Canada, you will find more than sufficient evidence to warrant you in concluding that initial contamination and the absence of steam in connection with the utensils, but particularly the man on the job, are all important considerations when attempting to define the causes of the spoilage of milk. And, therein, you will find crucial reasons for the present high cost of bacteria.

We have noted already the influences of age and prevailing temperature on the rate of spoilage of milk. Each of these contributory factors is of particular import; and the literature is replete with confirmatory evidence. I will content myself with one brief reference. Stocking of Cornell took duplicate samples of the same milk. One sample was kept for 12 hours at 40°F. and on examination proved to contain 9,000 bacteria per cc., and subsequently clotted in 75 hours. The duplicate sample of the same milk kept for 12 hours at 80°F. contained 55,000,000 bacteria per cc. and clotted in 28 hours.

The part played by transportation on the bacterial content of milk is of profound significance. Neither the producer nor the distributor has very much to say with respect to the type of transportation and the frequency of such that is provided. And the factors of age and temperature are to be considered in relation with transportation. In the work already cited of Harrison, Savage and Sadler on the milk supply of Montreal, we found the average of 250 samples taken in the rural districts and at rural stations to be 800,000 bacteria per cc. The average of 50 samples taken on arrival at the distributors' depots in the city was 1,000,000 bacteria per cc. This difference of 200,000 bacteria per cc. is to be attributed to time taken in transportation, prevailing temperature during such, and the inevitable slight increase in age of the milk. We cannot consider transportation without noting the very important effect exerted by the condition of the cans in which milk is transported from the country to the city. In some of the work of my department in our own University we have found in certain instances the condition of cans used for transportation to be such that immediately the milk is poured in prior to transportation an initial infection or contamination of 10,000 bacteria per cc. has taken place. It is to be understood that these cans were supposedly clean and sterilized. In spite of that, speaking most conservatively, the inoculation of the milk due to the non sterile condition of the cans alone would equal the bacterial content which it is stipulated that certified milk shall contain at the time of sale. Work carried out in the Old Country has shown that the initial contamination from this cause may vary from 170 bacteria per cc. to 240,000 bacteria per cc. At the Geneva Experimental Station in New York, Breed and his co-workers have obtained similar and, in some cases, even more unsatisfactory results. It would seem that lack of cleansing and lack of steam in treatment of cans which are to be used for the transportation of milk are a most serious menace: and the producer and distributor are obviously paying a high price for the bacteria which have arrived in the milk from such cans.

At this point, the losses experienced by those engaged in the butter-making and cheese-making industries were indicated and the arguments as presented above applied thereto.

We have noted already the four essentials which, it would seem, require to be subscribed to in order that spoilage and wastage may be avoided.

The principal measures to be adopted in the elimination of bacteria have been indicated. The inculcation and development of the bacteriological eye in the man on the job is the prime desideratum. The importance of the education of the producer, the distributor and the consumer cannot well be too much emphasized. For so long have the producer and distributor heard the slogan, 'educate yourselves in the fundamentals of your business.' that it is surely time for a modicum of this all essential education to be extended to the consumer. The consumer is prepared to be educated. And in the education of the consumer to an appreciation of the unique function of the producer and distributor—a specialized function necessitating adequate financial remuneration—lies in large measure, to my mind, one of the factors pertinent to the establishment of a sound and satisfactory milk supply. During the last two years educational competitions for the producers of milk have been inaugurated in the County of Essex in England, accompanied by generous awards. Of the 800 points allocated in the competitions, no less than one-half of these points are given for methods—such being dependent very largely upon the personnel engaged in the work. These competitions do much to develop the bacteriological eye. On this continent, thousand of dollars are being spent in wonderful advertisements. Milk campaigns are being held in many of our cities. One basic advertisement which would have unparalleled effect would be "Our Milk is pure, we guarantee it." A high class product of uniform quality, having a reasonably long 'period of usability,' distributed in all its pristine purity is the finest advertisement in the world. In the days that are to come, there seems little doubt in the minds of authorities in Europe and on this continent that milk will be placed on the shelves of the grocers' shops just as are other commodities of to-day. When that day comes, when we have our milk in the form of powder, the quality and satisfactory nature of the product will have been decided primarily by the success or non-success attending the measures adopted for the elimination of the bacterial flora of the raw material, milk.

It is not our purpose to say much on the question of legislation. It is to be hoped that legislation will be based on the feasible practical application of approved scientific findings. Certainly it is permissible to indicate that an enlightened public opinion will demand an adequate and satisfactory government of municipal control of all the avenues pertaining to the production and distribution of a commodity so vitally important as is milk.

Lastly a word of exhortation. For too long the exhortations enunciated by all of us have lacked that stimulation which is one of the main inducements in every sound business undertaking. We have not backed up our exhortations in terms of cash. We have not recognized the specialized nature of the function being performed by the producer and distributor of milk. The man who produces a higher grade of milk, milk having the 'maximum period of usability,' milk containing few bacteria, is producing a milk worth more money per pound of butter-fat than the man producing a low grade of milk, milk with a high bacterial content. But in each case the price paid per pound of butter fat is the same. In our creameries, the cream is bought on grade. The man with the bacteriological eye is paid in dollars and cents for cultivating and using that eye. Our laboratory methods today permit us to consider, as a practical procedure, the grading of milk on bacterial content. With the adoption of our 'clotting' tests we can go far. Breed of Geneva, working in co-operation with distributors and producers, and using the direct microscopic count of bacteria as control, has established experimentally the feasibility of buying milk on grade. We pay a higher price for quality in clothes. We pay a higher price and never question doing so, for the higher grades of butter. And still we hesitate to pay a higher price for the higher grades of milk.

Wealth in Stones

Contributed by the Department of Colonization and Development of the C. P. R.

The agricultural press of Canada no less than the Dominion Government's agricultural experts have recently devoted considerable space and time to pointing out the danger to be apprehended from soil exhaustion, particularly in the older settled and cultivated sections of the country. The fertility of our soil has been so great in the past that the possibility of its exhaustion has been regarded as a thing of the future, a danger with which the present generation is not concerned, and therefore, in a false security, farmers have not given the problem of fertilization and soil treatment the attention their importance warrants.

Canada is indeed, a country of prolific farming land but it is only necessary to take regard of certain unproductive, impoverished areas of the continent which formerly possessed the same high fertility, to realize that the richest land will deteriorate and fall off in its productive capabilities unless steps are taken in time to effectively offset and prevent this. In recent years there has undoubtedly been a decline in Canada's acreage production, some part of which is to be ascribed to exhaustion of the land and lower fertility brought about by poor methods of cultivation.

The Federal and Provincial Departments of Agriculture are contiually urging Canadian farmers to follow methods calculated to produce larger yields from the areas they already have in crop rather than in increasing the acreage and being unable to till it properly. Crop yields in general are very much below what is possible, in many cases below that which is profitable. Compare for instance, the achievements of Seager Wheeler and J. C. Hill with the harvests secured by the average farmer. Dr. Shutt, the chief chemist of the Dominion Experimental Farms says:—"We have now arrived at that stage where we must change from extensive to intensive farming. It is going to be easier and more profitable to farmers to get sixty bushels from one acre than to get thirty bushels from two acres."

Fertility of the soil depends on many factors not the least of which is the improvement of the soil. It is a postulate that what comes out of the soil must be put back if it is to be maintained with its productive powers unimpaired. One of the prime necessities for soil improvement is lime. Annual replenishing of the soil is necessary because the rainfall each year continually leaches the soil to such an extent that it becomes acid and the yields of nearly all common crops are reduced considerably. Expert agriculturists on both sides of the line are unanimous in the opinion that the cheapest, quickest and most prolific means of correcting this acidity is through the use of lime, and the wonder is that, supplies of this product being easily procured in almost all farming areas, lime is not in more general use by Canadian farmers, particularly in the provinces of Ontario and Quebec.

Lime occurs under different forms, burned lime water-slacked lime and ground limestone. The last is the most important for correction of soil; it is a simple material to handle and apply and under most conditions, the cheapest. Within certain limits it may be said that the more coarsely the limestone is ground the slower will be its action on the soil. Agronomists have recently and after elaborate experimentation reached the conclusion that the most economical form in which limestone should be applied to the soil is in the size of one-quarter inch and finer (almost the size of the average waste from commercial rock crushing plants). In this form, the limestone will be so graded that the finest particles will become almost immediately available to the soil, the coarser particles gradually taking effect and the coarsest (one-quarter inch) being a reserve supply available after all the finer have been utilized. Such application will need therefore, only to be made at longer intervals than if all the limestone applied were so fine as to be immediately utilized by the soil leaving no reserve supply for future seasons.

Dr. Shutt, the Dominion Government Agricultural Chemist, recommends that this crushed rock be applied from two to ten tons to the acre but generally about four tons to the acre will be required for practical purposes. The application offers no difficulties as a spreader may be used or the ground rock be distributed by a shovel from truck or wagon. The spreading may be done at any time of the year, the rock being suited to light loams, heavy clays and soil poor in organic matter. The material should be harrowed in on cropped land but merely spread on the surface of meadows or pastures. The coarser limestone described above can be applied once in four or five years, the finer ground limestone requiring more frequent applications.

The proven benefits to be derived from the use of lime on farm land should encourage all Canadian farmers to adopt its extensive use. The Washington Department of Agriculture states "that the application frequently pays a dividend of 100 per cent the first year and the profits in agriculture from its continual use are estimated to be from 300 per cent to 500 per cent." The same Department goes on to say that "if all sources of artificial chemical fertilizers failed, our total farm output could not only be maintained but even increased for a time simply by the application of lime to acreages that are now low in yield or lying fallow because they are too sour to grow profitable crops."

Quebec lands, according to the Provincial Chemist, are highly acid, in the proportion of 73 per cent, the balance being more or less acid or sour. This explains why many farms seem to be worn out. The same applies to certain sections of Ontario. Impoverished soils cannot produce good crops; lime is necessary and lime will more than double the production on these lands.

It is an old saying that a lime-stone country is a good country and every soil in Canada can be made a limestone soil by the application of pulverized limestone. Limestone is abundant in most parts of Canada, particularly in the provinces of Ontario and Quebec. There is no part of these provinces which cannot obtain a supply of limestone at reasonable cost. Why not have recourse to these supplies in view of the proven benefits which accrue?

Limestone can be cheaply transported to any farming area and pay for the expense incurred many times over. There is wealth in stone for Canadian farmers.

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NOTES.

P. Stewart, (O.A.C. '14) who has been with the Soldier Settlement Board for the past few years, is now with W. H. Dwyer & Company, seed merchants, Fort William, Ont.

Dr. Alex. McTaggart (O.A.C. '12) formerly agriculturist of the Department of Agriculture Museum at Wellington, New Zealand, has been appointed assistant Professor of Agronomy at Macdonald College. He will be in charge of plant breeding work, with special reference to grasses and clovers.

P. M. Daly (Macdonald '21) is taking post graduate work in horticulture at Morgantown, West Virginia.

G. E. Sanders (O.A.C. '07) is returning to Canada this month, to take charge of the manufacture of insecticides and fungicides for the Deoro Chemical Company. For the past year he has been with the Dosch Chemical Company at Louisville, Ky.

F. F. McKenzie (B.C. '21) is taking post-graduate work at the University of Missouri, Columbia, Mo.

SULPHUR RESEARCH FELLOWSHIP AWARDED.

Word has been received by Prof. J. H. Faull of the University of Toronto, that Miss Catherine Graham, B.S.A., of Guelph, Ont., has been awarded a sulphur research fellowship by the National Research Council, Washington, D. C. The fellowship carries with it the sum of $1,000 for 11 months service, with an additional $200 for travelling expenses and is the only one of its kind allotted by the Research Council to Canada. The fellowship requires that the work should be carried out in investigating purposes. Arrangements have already been made for experimental plots at Ottawa and in the Maritime Provinces.

Positions Advertised in the Dominion Department of Agriculture

4338. Assistant Chemist, Central Experimental Farm, to undertake analytical and investigational work with insecticides and fungicides. Initial salary $2,100, increasing by $120 each year up to a maximum of $2,530, supplemented by whatever bonus may be provided by law.

4339. Three Assistant Entomologists in the Entomological Branch. Initial salary $1,920, increasing by $120 each year up to a maximum of $2,280, supplemented by bonus.

4340. Field Husbandman, Central Experimental Farm. Initial salary $1,920, increasing by $120 each year up to a maximum of $2,400, supplemented by bonus.

4341. District Poultry Promoter, Live Stock Branch. Headquarters at Charlottetown, P.E.I. Initial salary $1,920, increasing by $120 each year up to a maximum of $2,400, supplemented by bonus.

4342. District Sheep Promoter, Live Stock Branch. Headquarters in Prince Edward Island. Initial salary $1,920, increasing by $120 each year up to a maximum of $2,400, supplemented by bonus.

4343. Three Sheep Promoters, Live Stock Branch, one for Quebec, one for New Brunswick and one for Nova Scotia. Initial salary $1,560, increasing by $60 each year up to a maximum of $1,920, supplemented by bonus.

4398. Chemist, Central Experimental Farm, for investigational work with soils and fertilizers. Initial salary $2,700, increasing by $120 each year up to a maximum of $3,180.

4400. Senior Agricultural Clerk. Central Experimental Farm, Initial salary $1,320. increasing by $60 each year up to maximum of $1,680, supplemented by bonus.

4402. Six Plant Pathologists, one each for Quebec, Nova Scotia, Ontario and Saskatchewan, and two for Manitoba. Initial salary $2,400 increasing by $120 each year up to a maximum of $2,760.

4403. District Live Stock Promoter for Manitoba. Initial salary $1,920, increasing by $120 each year up to a maximum of $2,400, supplemented by bonus.

4404. Supervisor of illustration Stations, for western Quebec. Initial salary $1,680, increasing by $120 each year up to a maximum of $2,100, supplemented by bonus.

4405...Two Assistants to Superitendent, at Experimental Farms, Lennoxville, P. Q. and Swift Current, Sask. Initial salary $1,500, increasing by $60 each year up to a maximum of $1,800, supplemented by bonus.

4406. Four Junior Entomologists, three for Eastern Canada and one for British Columbia. Initial salary $1,500, increasing by $60 each year up to a maximum of $1,800.

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A New Method of Corn Improvement by Selection

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In this paper it is not proposed to deal with the genetics of corn. The genetics of maize is too difficult and complex a subject for the average grower or farmer, who yet desires to 'improve' his yield of corn by such simple methods as he can command. This paper undertakes to describe a comparatively simple, and yet, it is believed, an effective method of corn 'improvement', by selection alone.

Methods of ear-to-row selection devised at several experiment stations in the United States, will be briefly discussed.

The literature list has been made unusually complete, for the benefit of those who desire to obtain as full information as possible upon the subject of corn selection.

After the introduction of ear-row breeding in Illinois in 1896, a number of experiment stations in the corn belt in the United States took up the work with various modifications. In 1905, Wiancko introduced the following system into Indiana (59a, p. 116). The general plan of corn improvement there instituted, consisted in the planting of 40 individual ear-rows, finally reduced to 50 hills each, having two to three stalks per hill. Ten of the best-appearing ears from the best stalks in each ear-row, were selected and kept separate. The yields of the individual ear-rows were then determined. The ten-ear lots which came from the sixteen best rows were saved as breeding ears, and the five best ears from the second best eight rows were also taken, and shelled together to plant the "bulk seed" rows. The seed from the remaining good ears from the sixteen best rows was then mixed, and used to plant a "multiplying plot", to provide superior seed for the main crops the following season.

In 1907, Ten Eyck reported the following plan of ear-row breeding from the Kansas Experiment Station, (56a.) Choice ears were selected from the general field and planted in ear-rows. After testing for yield, the highest-yielding ear-rows were mated by adjacent planting. At first, every other row was detasselled, but later, alternative halves of each row. Only the most desirable ears from the highest yielding detasselled rows or halves of rows were saved for breeding. One-fourth of each ear was kept in reserve, and the remnants from the highest producing ears were planted together as foundation stock for new breeding work.

By 1907, Williams (63d), had developed a complete system for the breeding of standard corn by selection, together with a system of registration. Briefly outlined, the method is as follows. An ear-row series is planted in duplicate, a check-row alternating with each five ear-rows to be tested. A block of fifty ear-rows, exclusive of checks, is thus planted in duplicate, Nos. 1 and 26 being planted from ear 1, Nos. 2 and 27 from ear 2, etc. Two ear-rows are planted to fifty hills each, from one-half to two thirds of the seed from each ear being used. The stand is later thinned to the same number of plants per row. Full data are kept of all the principal vegetative characters. The next year, the ear remnants left over and not planted from the row-tested ears, are planted in short rows,—the same sire-rows alternating with several dam-rows, the latter being detasselled to ensure crossing. An experiment following this method in the case of Leaming corn, gave an excess of 7.7 bushels per acre over the original Leaming planted alongside. The complete cycle according to the Williams method is therefore, as follows:—

First year. Selection of ears from selected plants of the general crop.

Second Year. Duplicate ear-row test.

Third Year. Remnants of highest yielding ears of the preceding years' ear-row tests, are crossed with a single sire in the breeding plot.

Fourth Year. Registered ears from the preceding year's breeding plot, are grown in ear-row tests, and also in multiplying plots.

Fifth Year. Seed from the ear-row tests above, go into the multiplying plots, and seed from the multiplying plot goes to sow the general crop.

In 1908, Bull published (1, pp. 202-226) the results of five years' experiments in corn breeding at the Minnesota Experiment Station. The foundation or stock plots, were handled on what was known as the "centgener system", the plants being grown on what were called "centgener plots", in hundreds or multiples thereof. At maturity, the centgener plots were inspected, and those showing low yields were discarded. From each of the remainder, the best five to ten ears were saved separately. After curing in January, the dry weights of the centgener yields were taken, and the best ten or fifteen were selected out. The five to ten best ears belonging to each of these, already selected in the field, were all graded according to a score-card, by the same individual, to eliminate the personal equation. After this, the ears were weighed, the number of rows and the circumference measured, and the ratio of shelled corn to weight of ear determined. In all, fifty centgener foundation plots were found to be a satisfactory number. From 100 to 250 of the very best shaped and most perfect appearing kernels from the selected ears, are counted out for planting the centgener row plots the next season. The following year, ears and kernels selected in the same way from the centgener ear-rows, are used for the centgener ear-row plot tests of the succeeding year, while from the remaining good ears of the centgener row plots, an increase plot is annually planted, from which the best ears are saved to plant general field plots the subsequent year. By this method, field results are obtained in the third year. To avoid deterioration in the successive annual centgener row plots through too close fertilization, it was planned to introduce into the centgener row plots about every five years, alternate rows from the foundation block, the rows derived from the centgener row test ears being detasselled. The well known northern corn called Minnesota No. 13, was bred for five years according to this method, yielding 70 bushels of shelled corn per acre in 1906.

Miller and Hughes (37) introduced the following modification of the Illinois breeding system at the Missouri Experiment Station in 1910. They favor a test plot of about 100 ear-rows, each from 75 to 100 hills long, one-half the ear being shelled for planting, the other half preserved. The following year, the remnants of the few high-yielding ears were planted together. They do not favor the system of continuous consecutive selection from the high-yielding ear-rows of each year from which to grow the breeding block of the next year, on account of the mixing which occurs within the block, and the time and labor required in the operations.

In 1912, Roberts and Kinney (46) reported from the Kentucky Experiment Station, their system of ear-row breeding. Twenty-five to fifty ears are selected to the desired types, from the field crop in the fall. These are planted in ear-rows of one hundred hills per row, with five seeds to the hill, thinned when the plants are four or five inches high, to two or three plants, so that each row shall contain as nearly as possible the same number of stalks per row. If possible, the series should be duplicated. At tasselling time, the tassels are to be removed from alternate halves of each row to ensure crossing, thus

Row 1. ——————.....

Row 2. .....——————

At maturity, the yield of each row is weighed, keeping the ears from the detasselled parts separate, the corn from the portions not detasselled being discarded after weighing. From the best four or five rows, ears are selected for the next year's test, the best of the corn from the remainder of the block being used for planting the general crop the following year. The breeding block is continued from year to year, care being taken not to plant in adjacent rows, ears previously grown adjacent. It is advised that occasionally a few ears of corn of similar type obtained from another grower be introduced.

A further elaboration of this method was also followed. Ear-rows are planted as above, the remnants of the ears from which they are planted being carefully saved. None of the

rows are detasselled, the sole object being to get comparative yields. The best-yielding rows are determined as before. The next year, the ear-remnants from the best yielding rows of the previous season are planted in small, isolated breeding blocks to produce seed for planting the general crop.

In 1916, Noll (42) reported the following plan of corn breeding in practice at the Pennsylvania Experiment Station since 1912, with the variety known as Clarage. Half the grain from selected ears is planted in ear-rows, every sixth row being planted with mixed, field-grown seed of the same variety as that from which the ears were derived. The following year, the remnants of the most productive ears are planted in small, isolated plots and cross-pollinated. In each of these crossing plots, one ear, selected as the pollen parent, is planted every second or third row. By the third year, the best of the ears from the crosses secured in this way, are returned to another ear-row plot, the remainder being used to plant an increase plot to produce seed for the field.

As a general conclusion to this brief sketch of the history of ear-to-row breeding methods at certain of the American experiment stations, it should be emphasized that the prime essential so often and so largely overlooked in work of this kind, is the necessity for taking the plant and not the ear as the starting point. The correct point of view in the matter is nowhere better stated than in the words of Pearl (43).

"Among the most careful and thoughtful of the corn-belt farmers and breeders of seed corn there is developing a marked reaction from the belief in the great value of the "show" type of ears for seed raising purposes. It is being found by corn breeders everywhere that such ears do not always, or even in the majority of cases, produce the highest yields or the largest proportion of perfect ears." (p. 275).

"In selecting corn for seed the *selection must be on the basis of the performance of the progeny*, (*here the row*), *as distinct from individual ear selection.* The best ears to select for seed are those which come from good rows. A poor ear from a good row is vastly better than good ears from a poor row, when the planting is on the ear-to-row system." (p. 283).

PRACTICAL CORN IMPROVEMENT

Practical success in breeding Indian corn for yield, depends upon two more or less mutually excluding principles,—that of obtaining high-yielding pure lines or 'genotypes', and that of maintaining a relatively cross-fertilized or heterozygous condition in the mass. Corn being a cross-pollinated plant, it is a practical impossibility to maintain purity of stock for any great length of time under average field conditions, anywhere within a corn-growing neighborhood, even though a relatively pure line were isolated at the beginning. Furthermore, the difficulty of isolating high-yielding genotypes among constantly close-fertilized strains of corn, is a not inconsiderable task. However, in connection with the practical work of ear-row breeding, it is not impossible for the breeder to carry on a parallel series of self-pollinated ears, with a view to isolating high-yielding genotypes, if possible. The writer has been able to carry pure lines of corn for nine years with no sign of deterioration due to in-breeding.

As East also says (11a):

"Rows grown from ears which had been selfed for two or three generations, were exceedingly uniform in all of their botanical characters, and while they did not yield as well as the crossed rows, nothing was seen that could be called "degeneration". The plants were perfectly healthy and normal in all their functions." (p. 426).

As far as the practical matter of getting "good ears" with plenty of seed is concerned, the writer has been able, with improved technique, by a method elsewhere described, (47), to get as satisfactory and as well-filled ears as are obtained under ordinary field conditions.

Regarding the general method of ear-row breeding, Pearl says, (43):

"We are very much inclined to believe that in actual practice, substantially as good results may be obtained by a general ear-to-row selection method, relaxed in intensity after a few years, as by the use of the more elaborate and costly "pure line method of corn breeding" of Shull. The latter method is probably right in principle, but the former method, in a much cruder and less precise way, really makes use of the same principle.

Continued ear-to-row breeding (without too close pedigree selection), is continually testing out different heterozygous types, and rejecting the undesirable ones. Presently a point will be reached, where the great majority, if not all of the more strikingly undesirable genotypes, (which when crossed produce the undesirable heterozygotes), will have been automatically eliminated. We shall then have reached, by a much slower route, the same goal which Shull attains quickly and directly by the 'pure-line' method."

As East says, (11 a, p. 421):

"The all-important fact, although the cause is unknown, is that *crosses between nearly related types are more vigorous than either of the types alone.* Self-fertilization in corn, therefore, simply isolates biotypes, and these by themselves are generally less vigorous than the hybrids continually formed in nature by inter-crossing." (p. 423).

In practical corn breeding, three distinct aims and methods must be kept clearly in mind: (1) the method of the experiment station, (2) the method of the commercial breeder, and (3) the method of the practical farmer.

(1) The Method of the Experiment Station.

The primary work of the experiment station is to isolate, so far as possible, the highest yielding biotypes of corn for crossing. Scientifically speaking, this would be the method of Shull (52 a, b, c, d), of isolating by continued selfing, high-yielding biotypes, to be annually crossed for the sake of the higher yields to be gotten from F_1 seed. So far as the writer knows, this method has never been put into actual practice, except in the loose modification of it in the ear-row system of breeding. The system involves some practical difficulties, which will be referred to later. Agronomists, who would naturally undertake such work, have generally a well-grounded prejudice against growing 'inbred' races of corn.

The writer would undertake to propose the following method for experiment stations engaging in the breeding of corn, which embodies a modification of the Williams system, and of the pure line method of Shull.

Let one hundred ear-rows be grown from ears selected to type, taken from the oldest reputed best-yielding variety of the farming region in which the experiment station itself is located.

Notes as to vigor and rate of growth of the ear-rows, should be taken, from the time the plants first appear until full vegetative maturity, i.e about silking time. Plants should then be selected in the field for thriftiness, vigor, leafiness, medium height of stalk and of ear location, etc., in the best appearing ear-rows of the plot. Promptness and vigor of germination of the different ear-rows, should be carefully taken into account. Ears on the selected plants should all be sacked and close pollinated by hand. At harvest, the highest-yielding rows should be determined, and from these, the superior ears from the tagged stalks should be selected out *by weight.*

From these selected superior ears to be bred into genotypes, an ear-row plot should be planted the following year as before, keeping an accurate registry of ear derivation in all cases, and repeating the selection, selfing, harvesting and weighing of the ear-rows in exactly the same manner.

It should be possible in this way, to get relatively pure biotypes in from three to six years. As soon as this becomes evident through the absence of segregates splitting off, without awaiting further ideal purification of the type, ear-rows should be grown from the best selected ears of these emerging biotypes, in which a considerable number of the plants should be close fertilized by hand pollination. This will give a fair amount of seed for practical planting purposes. If the inferior ear-row types are annually eliminated, and only the manifestly superior ones grown, there will result no degeneration due to continued self-fertilization. This is, at least, the writer's experience in the conduct of other experiments with corn, selfing through a period of years, and the writer's experience in this regard is in accord with that of East (11 b. p. 426). The object is to follow the method of Shull, and to cross the two highest-yielding biotypes or partial biotypes, now present in comparatively bulk lots of selfed seed ears. To this end, the writer would recommend mixing thoroughly the shelled seed from the best ears of the two bulk lots, to be sown in an isolated field for the production of seed ears for multiplying plots, from which seed

ears are to be obtained by successive plant and ear selection by the ordinary methods, and without continuing hand pollination.

According to the demands of Shull's method, on account of the superior yield of the first generation hybrids over that of their selfed parents, it would be a matter of continuous necessity on the part of an experiment station to produce an otherwise practically unattainable amount of F_1 seed ears for distribution to farmers, since the superior yields are derived from growing the F_1 seed. However, it is the writer's opinion, that by maintaining a progressively upward series of selections of superior selfed biotypes, ultimately to be reduced to a few standard best, to be annually self-fertilized in quantity in ear-rows, it would be possible to obtain a sufficient number of F_1 seed ears every year, the seed which can be mixed and grown in the multiplying plot. In time it is probable that two such standard maximum biotypes can be isolated, which could be maintained indefinitely for annual crossing purposes without degeneration, and even though it be impossible to furnish the hybrid seed to farmers, it would still be possible by line breeding from the best biotypes, to maintain a high standard of yield in the multiplying plot.

So far as degeneration is concerned, it simply means the isolation, within the pure line or biotype, of a complex of inferior,—possibly in some cases in the sense of an insufficient number,—of the necessary factorial units or 'genes', or in other cases, an ill-fitting combination of the same. It is by this modification of Shull's scientific method, that the writer believes the experiment station is most justified in proceeding, in what may be called a practical manner. A diagram showing the method of procedure is given on Plate 1.

(2) Commercial Corn Breeding.

For the commercial seed grower, whose object is to make a profit from growing seed corn, the maximum results at the least possible cost are demanded. It is sufficiently demonstrated that the selection of show type ears by score-card characters alone, from bulk lots of seed, will not necessarily raise the yield of corn in pounds of shelled grain per acre. Nevertheless, uniform ears of a standard type appearance, establish a brand reputation for commercial purposes, that is profitable as a species of trade mark, and that figures in the possible price asked. The writer believes, that for the commercial grower of seed corn in the ear, a modification of the Williams' method is the most feasible. The modified plan is outlined as follows:

The first year, ears are field-selected from thrifty plants of the standard varieties to be grown for sale, remembering, of course, that it is impossible to grow on one piece of ground with equal success, seed corn of varieties suited to all portions of the corn belt. These field-selected ears should, if possible, be weighed individually after curing, and the heaviest taken for re-selection on a modification of the score-card system, in order to secure conformity to a selling type.

The second season, these selected best ears should be grown in blocks of one hundred ear-rows each, the ear-rows being planted in duplicate if possible, within the block, rows 1-25 being followed by rows 26-50; or rows 1, 3, 5, 7, ...25, being alternated with rows 2, 4, 6, 8, ...50. The latter method of alternating duplication, however, involves extra time in planting, disproportionate to the advantage over simple successive duplication, so far as commercial advantages are concerned. In many, and perhaps in most cases of private growers, duplication of the ear-rows will be entirely precluded on account both of the extra labor involved throughout, and of the danger of confusion in handling through inexperienced help. At all events, a check plot of the same size, of a local standard variety of established reputation, should be grown between the ear-row breeding blocks, separated therefrom by border plots of Russian sunflower, the seed of which of course, is a commercial product as such, or can be used as feed in poultry raising, carried on as a side line. Sorghum instead of sunflower can of course be grown in border plots if desired.

All ear-row plots and check blocks should be of equal length, using preferably one hundred feet as a standard, and the plants, where practicable, should be thinned to the same number per row, although the cost of labor will virtually preclude this extra item in some cases. The most vigorous ear-rows

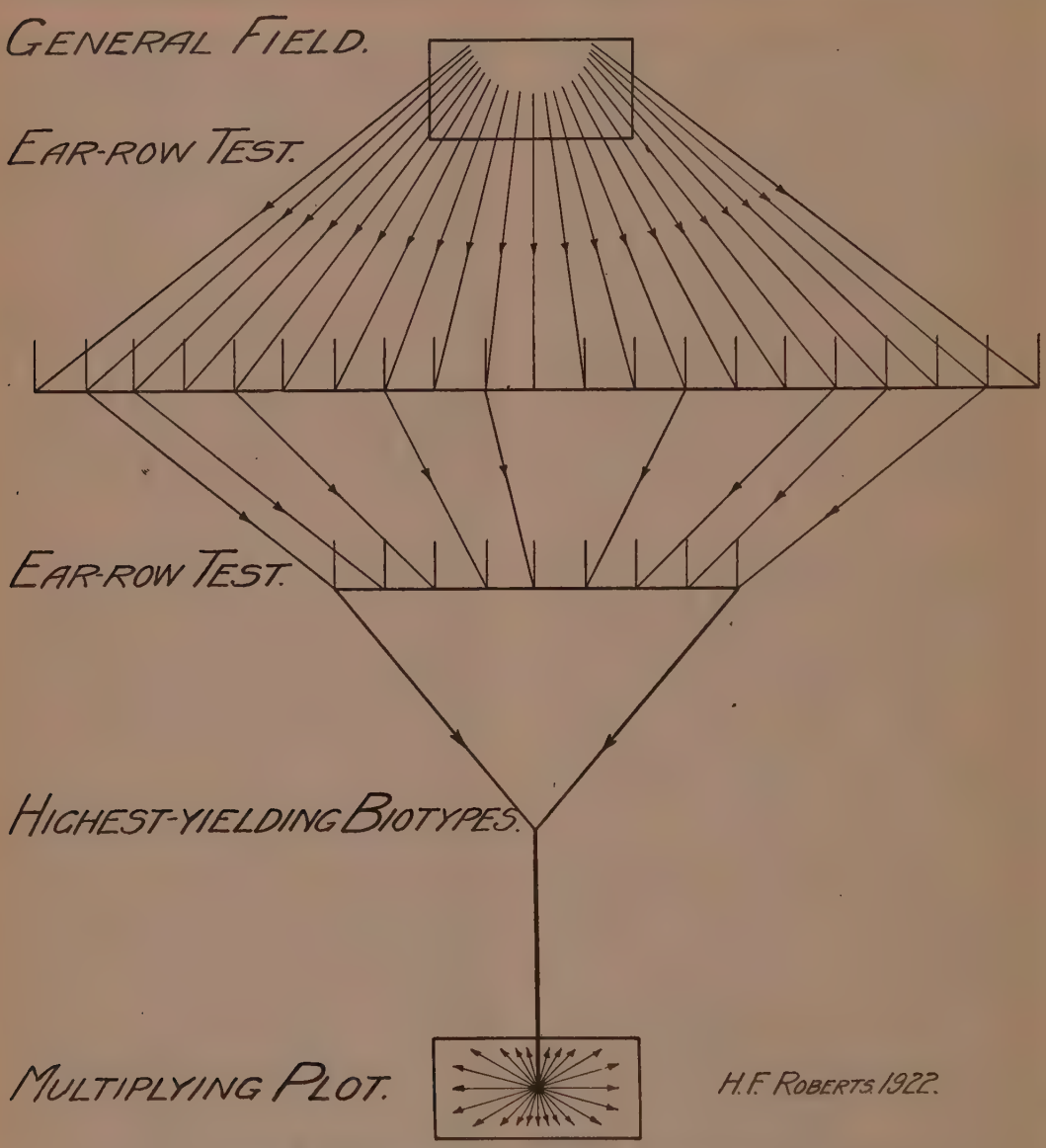

PLATE 1.—CORN BREEDING METHOD FOR EXPERIMENT STATIONS.

From corn in the general field, ears are selected for ear-row tests for any number of successive years, (two shown here), from which, finally, ears representing the highest-yielding biotypes are taken, the seed mixed and sown together in a multiplying plot, whence seed ears are sold to farmers.

should be noted from the time the plants come above the ground, and after pollination, when the ears are set, and the silks have turned brown, the grower should carefully go over his best rows, as evidenced by his field thus far, and tag the ears on the heaviest and thriftiest plants. If 'tie-tags' are bought,—i. e. tags with the strings already threaded,—it is a simple matter to knot the ends in large numbers in advance, so that the tags can be slipped over the ear-shank by simply threading them through, thus obviating the tedious labor of tying.

At the end of the season, the ear-rows should be harvested separately and weighed in the field, the tagged ears included. The latter are then saved separately and weighed

in the field, the tagged ears included. The latter are then saved separately for seed purposes, the best appearing of the remaining ears, of the best-yielding ear-rows, being saved for planting in a mixture in a multiplying plot the next year, and the balance consigned to the crib for feeding purposes.

The third year, three breeding plots should be maintained.

A. A breeding plot of one hundred ear-rows as before, planted from weighed and scored ears, chosen from the field-selected ears of the best yielding ear-rows of the previous season as above described. These ears should be numbered, and a register kept of their ear-row derivations, thus constituting a continuous pedigree record, which may be useful for commercial or advertising purposes.

This A—plot is the "pedigree line" or "ear-row" plot, to be kept in continuation, year after year, for line breeding purposes.

B. This is a plot planted with mixed seed from the ear-remnants of those ears from which the seed was taken, which planted the highest yielding ear-rows of the preceding season. This plot is called the "stock supply plot" and is kept in continuation year after year for continuous re-selection of seed ears by the method first described. In fact, after this system is started, this plot constitutes the foundation plot from which all additional ears for row-breeding in the A—plot are to be derived. Breeding by line selection from the A-plot alone can be carried out, but it tends to continually narrow the ancestry. By the continual introduction of new ear-rows from without the A-plot, the ancestry is constantly carried in the direction of gradual yield improvement, and yet is kept from too close in-breeding, with the consequent loss of many ear-rows through a deficiency of the necessary hereditary factors in the plants. The B-plot seed is, of course, steadily added to, through the continual addition of the ear-remnants from the seed ears from which the highest yielding ear-rows of the A-plot annually come. There is thus maintained a revolving series of presumably progressing yield value, (within certain limits), that is still kept widely intercrossed, and hence maintains that proper balance of characters which appears to be normal for the best results in Indian Corn.

From the B seed-plot when established, there are then annually taken field-selected ears as at the very beginning, to be annually added to the ear-row plots. In the planting of the latter, it will be well to alternate the new ear numbers derived from the B-plot, with the line ears obtained by a line selection within the A-plot rows to ensure constant cross-pollination. There is thus established a seed reservoir, which will obviate the necessity of the grower going at intervals, as frequently recommended, to outside sources for new seed. From the balance of the B-plot, the ears not field-selected for renovation of the A ear-plot row, are harvested in the usual manner. Seed ears are selected in the field from the wagon, and afterwards re-selected by score-card system, to be planted the next season; being mixed and planted in bulk in what may be called the C-plot or multiplying plot.

C. From the C-plot, or multiplying plot, the seed ears for sale to farmers as No. 1 grade are to be selected,—first taken from the wagon as harvested, and afterwards as standardized by the simplest possible system—properly filled butts and tips, straight rows, proper type of kernel, proper length, size, shape of ear, etc., being characteristics that a practiced eye and hand soon learn, so that sorting can be done almost automatically. The ears can then be stored in drying racks and left until January, when they can be crated for shipment. It may be necessary to save seed ears derived from the multiplying plot for planting in a larger seed plot to provide a larger source of seed corn for sale.

Stock raising should, of course, be combined with the seed corn business, in order to return manure to the land, and use the bulk of unmarketable seed from the field profitably, through feeding. Probably a combined cattle, hog, and seed-corn farm would be the most profitable combination, since that would allow of a grass pasture, alfalfa pasture and hay, cultivated corn land, and tame hay rotation that would bring the best combined results as a permanent project.

It should be added that it is advisable, if possible, for commercial corn breeders to confine themselves to the growing of a single variety for sale.

The general scheme may be presented in the form of a diagram as follows, on Plate 2.

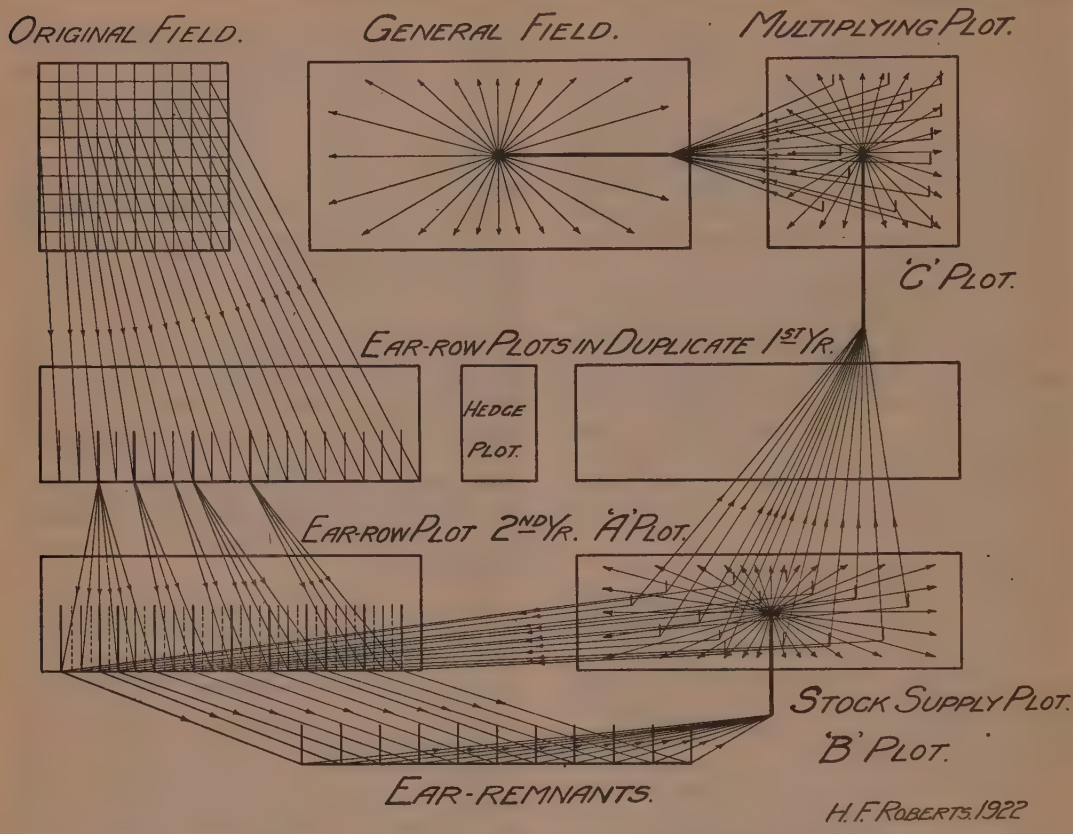

PLATE 2.—METHOD FOR THE COMMERCIAL BREEDING OF CORN.

From the original field, selected ears are grown in an ear-row test for two years. The second year, the ear-remnants representing the ears which produced the best yielding ear-rows in the second row-plot, (the "A-plot"), have their seed mixed together and sown in what is known as the "Stock-Supply Plot," (the "B-plot"), from which, on the one hand, a rotation series is run with seed from field-selected ears, which are grown annually in the ear-row plot, ("A-plot"), while on the other hand, half the seed from the field-selected ears as above, is mixed together and used to plant the "Multiplying Plot," or ("C-plot"), from which, in turn, field-selected ears again furnish seed which is mixed and used to plant the general field. Seed ears for sale are taken first from the multiplying plot and finally from the general field.

(3) Corn Breeding for Farmers.

The practical farmer has necessarily to eliminate inessential work and complicated details from any scheme of corn improvement. The following method will be practicable for many farmers to carry out.

(1). From the general field, select the best ears, *from the best stalks* if possible, of a standard variety long grown with success in the vicinity, or coming well recommended. These ears should be graded according to a reliable, *practical*, and not too complicated score-card system. *Preferably the ears should be weighed first, and the heaviest taken for scoring.* The score-card to be used can be gotten from any experiment station in a corn-growing region. The ears selected should then be numbered and hung in a dry place to cure.

(2). The following season, half the seed from each ear should be planted in a numbered row. The greater the number of rows, the wider will be the choice for selection, but, by the same token, the greater will be the amount of detail work required. At harvest, the yield of each ear-row should be weighed separately, and half the best ears saved from the best rows should be mixed together for planting the general field the following year. The remaining half-ears,

shelled and mixed together, should be planted in a breeding block, kept as isolated as possible from the general field.

3. The third season, the best ears should be selected from the breeding block just described, for planting the ear-row plot the *succeeding season*. The next best ears should be saved for planting the general field. By this method, the ear-to-row work will be required only every alternate year, and there will still be constantly maintained a breeding block for selection purposes, which will furnish a tolerably high yielding standard of ears for the field, and which will yet not involve too close in-breeding. A diagram of the method proposed is shown in Plate 3.

In conclusion, it cannot be too strongly emphasized, that in corn breeding work, as in the breeding of all other plants, the individual plant always constitutes the unit from which to commence, and in selecting the individual, its performance through its progeny constitutes the only criterion of its breeding value. As Pearl says (43).

"The great bulk of data regarding inheritance accumulated by the experimental work of recent years support the generalization that the external visible characteristics of a plant or animal furnish an exeeedingly unreliable criterion of its probable behavior in breeding. The fact that an ear of corn is of especially good type and appearance is no guarantee that its progeny will also be better than the average." (p. 275).

The fact that corn is widely cross-pollinated, confines the selection largely to the seed parents as a matter of course, but by continuous selection of these, and the practice of a rotation system of ear-to-row breeding as described above, the ultimate outcome will be a standardized strain of uniform characteristics and performance.

SUMMARY.

1. The earliest records of any observations which may be said to bear upon the breeding of corn, are those of Camerarius in 1694 and Logan in 1739.

2. The first actual work of importance in the improvement of dent corn by ear selection in the United States was that of Leaming, Reid and Riley from 1826-1876, in Ohio, Indiana and Illinois.

3. Breeding for chemical composition of the kernel was begun by Hopkins of the Illinois Experiment Station in 1896. The difference between corn selected for high and low protein increased in ten years from 0.65% to 5.72%—an increase of 5.07% due to continuous selection of biotypes. Hopkins demonstrated the kernels of an ear of corn to be approximately uniform in their percentage of protein. At the Kansas Experiment Station, reported by Willard, 1902, an advance in protein content of 1% by selection in three years was obtained. At the Indiana Experiment Station, Wiancko in 1903, reported an increase of 2% in three years. In South Dakota, Hume in 1914, reported differences of from 1.5% to 2.84% between the low and the high protein strains.

In Illinois from 1896-1906, in selection for low and high oil, the advance reported was from 0.67% to 4.71%—an increase of 4.04%. In Nebraska, Lyon in 1905 reported, as the result of three years' selection, variation, from a loss of 1.11% to a gain of 0.16%. From South Dakota, Hume reported in 1914 an increase of 2.63% in two years in the high-oil strain, and a decrease of 0.32% in the low-oil strain.

4. Since 1900, experiments have been conducted to determine the possible relation between seed-ear characters and yield. The facts, so far as the data justify, may be stated as follows:—

(1) Tillering.

Relatively higher yields are obtained from more rather than from less highly tillering strains.

(2) Twin ears.

Higher yields are produced from strains bearing more than one ear per stalk, but as a practical matter, a twin-eared strain seems impractical for field conditions, on account of the extra labor of harvesting, as corn is usually handled.

(3) Height of ear.

Selection for high and for low-ear strains has resulted in a total difference of about two and one-half feet between them, with results as to yield in favor of the low-ear strain, of from 1-2 bushels per acre.

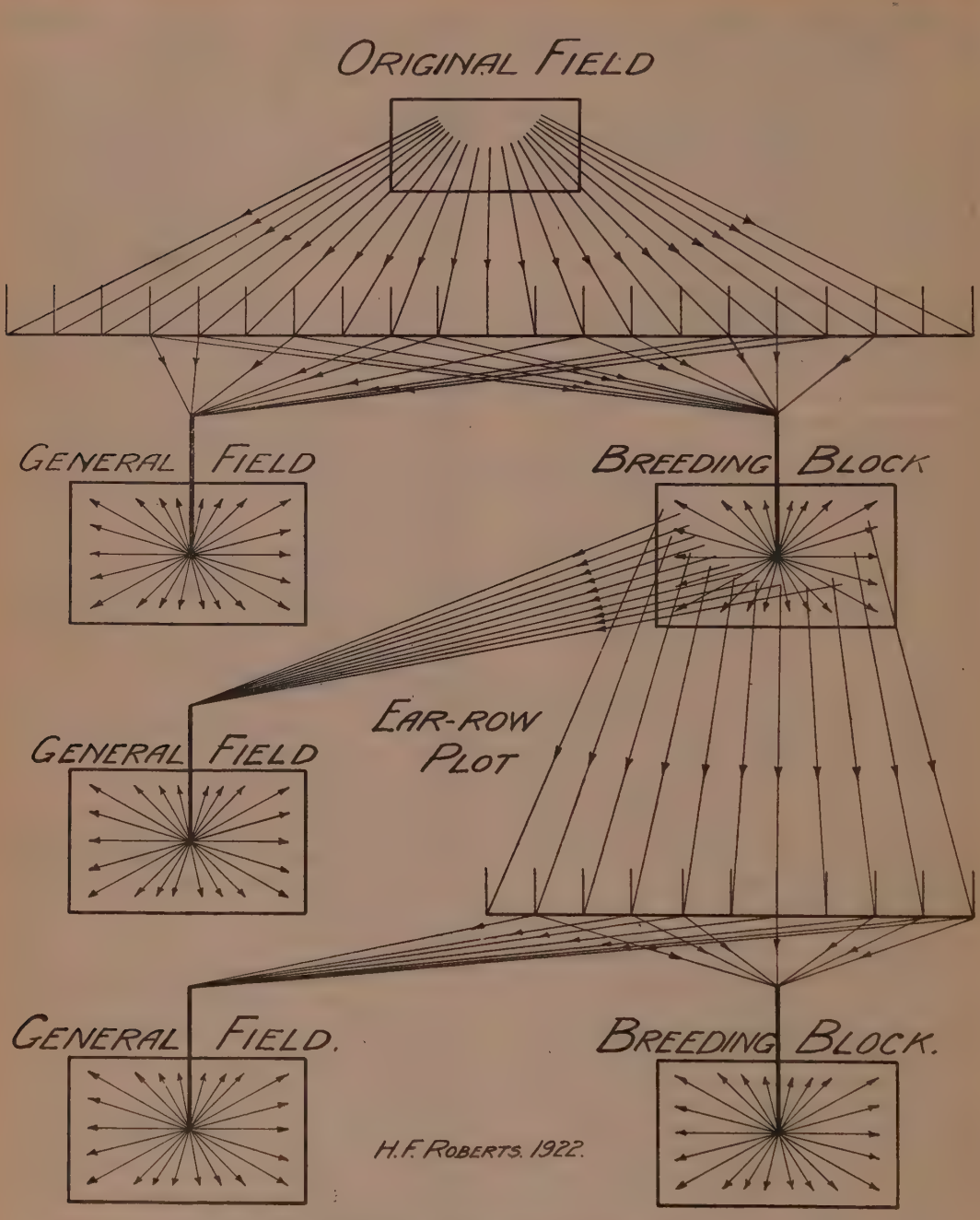

PLATE 3.—METHOD OF CORN BREEDING FOR FARMERS.

From the original field, ears are selected and grown in an ear-row. From the best-yielding rows, ears are taken, half the seed being used to plant the general field, and half, the breeding block. From the breeding block, seed-ears are taken, half the seed being used mixed together the following season to plant the general field, and half, the breeding block. By this method, the ear-row plot is required only in alternate years.

(4) Weight of ears.

The selection of heavier seed-ears has resulted in a reported increase of from 1-6 bushels per acre in yield. However, there is a distinct conflict in the reported correlation between weight of seed-ear and yield from the biometric standpoint, Pearl's data (43) furnishing a coefficient of 0.78, and Love and Wentz (34) finding a coefficient of but 0.13.

(5) Percentage of grain.

Selection for high percentage of grain to the ear, has resulted in an inerease in yield in some cases, but not to the same extent as selection based on weight of ear. The correlation coefficient between percentage of grain and yield does not exceed 0.17%.

(6) Form of ear.

A difference of one and one-half bushels per acre has been found in favor of the selection of the tapering type of ear, although the mathematical correlation between form or type of ear and yield, shows practically no correlation,—about 0.09.

(7) Length of ear.

Average increased yields of from one-half bushel to nearly five bushels per acre are reported as the result of the selection of longer seed-ears. The data are somewhat in conflict however, and the average correlation coefficient is only 0.17.

(8) Circumference of ear.

Data inconclusive.

(9) Number of rows of kernels.

Selection for an increased number of rows, results in increase of yield up to 20-rowed ears, selection of partially isolated ear biotypes giving a mode close to the ear type selected for.

(10) Rough and smooth ears.

Results contradictory.

(11) Form of kernel.

Certain experiments indicate the optimum size of kernel to have a ratio of width to length of 1:1.5 to 1: 1.8.

(12) Color of the grain.

The data in general indicate that white varieties of corn outyield yellow varieties on the average.

(13) Correlations.

The average results from a series of correlation calculations for ten ear characters correlated with yield, give a total average coefficient of only 0.076. Coefficients calculated for six ear characters and time of maturing showed no correlation.

5. The results of the ear-to-row system of breeding, according to the data from five experiment stations, show that an average range of about 20 bushels may be expected between the yield of the highest and that of the lowest yielding ear-rows.

6. Systems of ear-row breeding were reported from the Illinois, Indiana, Kansas, Kentucky, Minnesota, Missouri, Ohio and Pennsylvania Experiment Stations, the Ohio method furnishing perhaps the best combination of science and practicability for experiment station purposes; the Missouri method being preferable for the individual farmer.

7. The writer proposes three methods of corn breeding, embodying modifications of the methods advocated by Shull (52), by Williams of Ohio (63d) and by Miller and Hughes, of Missouri (37).

(1) The writer's experiment station method, advocates the growing of pure-line high-yielding biotypes, according to the method recommended by Shull, seed from which is to be mixed and sown together in a multiplying plot, from which seed-ears for general purposes are to be obtained in the ordinary manner..

(2) The commercial method recommended, is a modification of the Ohio system of Williams.

(a) A breeding plot of ear-rows is planted with seed from weighed and scored ears, chosen from among field-selected ears from the best yielding ear-rows of the previous season. This is known as the '*A-plot*' or "*pedigree-line plot*".

(b) A plot is planted with mixed seed from the ear-remnants of those ears from

which the seed was taken which planted the highest-yielding ear-rows of the preceding season. This is the foundation plot from which additional ears are annually selected to grow in the ear-row breeding plot. This plot constitutes a seed reservoir and is known as the *'B-plot'* or *"stock-supply plot"*.

(3) The method recommended for farmers consists—

(a) in selecting the best ears, (from field-selected plants if possible), from which to grow an ear-to-row plot. At harvest time, half the seed from the best ears from the best yielding rows, should be mixed together and used for planting the general field; the seed from the remaining half-ears being mixed and planted in an isolated breeding block.

(b) The best ears from the breeding block should be planted in an ear-to-row plot the following season. In this way the ear-row plot will be needed *only every alternate season*, and a breeding block will be constantly maintained for selection purposes.

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Insect Legislation in Canada*

BY L. S. McLAINE

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Mr. W. H. Lyne (1) in two of his papers presented before the members of the Western Plant Quarantine Board, outlined the basis of insect pest legislation in Canada but laid special emphasis on the legislation in force in the province of British Columbia. Consequently it may be of interest to review briefly the Federal legislation in force in Canada to-day.

One of the first laws in Canada dealing with insects was passed in 1883 in the Province of Prince Edward Island and entitled "An Act to Prevent the Spread of the Potato Bug in Prince Edward Island". The administering of the act was placed in the hands of the School Trustees in the school districts and they appointed inspectors and levied taxes for the control of the pest.

In 1894 the San José Scale (2) was discovered in the Province of British Columbia and two years later an act was passed by the Provincial legislature creating a Horticultural Board and instituting an inspection service. From that time the province of British Columbia made rapid strides in the development of the service involving the inspection of plant products and they now have a most efficient and effective organization.

All the provinces of Canada have legislation dealing with the control of insect pests on their statute books, but British Columbia is the only province that requires the inspection or fumigation of nursery stock or other products entering the province and originating in any of the other provinces of the Dominion. The Province of Nova Scotia, however, requires that all shipments of nursery stock entering the province from other provinces shall be fumigated and inspected before being shipped. Nursery stock must be accompanied by a certificate of inspection or fumigation signed by an authorized official and all shipments arriving in the province without such certificates are returned by the transportation companies to the shippers. Ontario has a nursery inspection law and inspects all nurseries and all grounds within half a mile of the nursery at least once each year; furthermore, nursery stock is fumigated before being shipped. There is also a regulation prohibiting the importation of plants affected with disease. New Brunswick and Quebec also inspect their nurseries each year. Manitoba, Saskatchewan and Alberta all have regulations dealing with the control of grasshoppers.

The history of federal legislation in Canada is somewhat similar to that in the United States and practically dates from the time the San Jose Scale was discovered in eastern Canada. On March 18th, 1898, the San Jose Scale Act was passed: this act prohibited the importation of any trees, shrubs, plants, vines, grafts, cuttings or buds from any country to which the act applied, and provided further for the importation of plants not subject to the scale. The regulation applied to the United States, Australia, Japan and the Hawaiian Islands. The Act was amended on April 4th, 1900, to permit the importation of nursery stock from the countries named above, but the shipments had to enter through certain ports and be fumigated with hydrocyanic acid gas.

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* Paper presented at the meetings of the Western Plant Quarantine Board, Sacramento, Cal., June 2nd, 1922.

1. Mr. W. H. Lyne, Horticultural Quarantine in British Columbia, Monthly Bull. Cal. Dept. of Agr. Vol. VIII, No. 8, August 1919; Plant Quarantine Problems Affecting British Columbia, ibid Vol. IX, No. 7, July, 1920.

2. Report of the Dominion Entomologist, 1894, page 206.

In 1909 large amounts of nursery stock were imported from France into both the United States and Canada. As a result of 1800 brown tail (3) nests being found on nursery stock imported into the state of New York, an active campaign was started to inspect all nursery stock entering Canada. From one million and a half seedlings consigned to points in Ontario and Quebec 196 nests were removed. The brown tail moth was established in the New England states and was then doing great damage. It was realized that some legislation must be enacted which would permit the inspection of imported plant products as this could not be done under the Act then in force. In the fall of that year the late Dr. C. Gordon Hewitt was appointed Dominion Entomologist and one of his first and most important duties was to draw up suitable legislation to meet the situation.

On May 4th, 1910, the San Jose Scale Act was rescinded and the new Destructive Insect and Pest Act pas passed. This latter Act which is still in force, has been found to be entirely satisfactory for all purposes and no amendments or emendations have been made.

The Destructive Insect and Pest Act (4) provides for the Governor General in Council to make such regulations as are deemed expedient to prevent the introduction or admission into Canada, or the spreading therein, of any insect, pest or disease destructive to vegetation. These regulations may provide:

(a) for the prohibition generally or from any country, of any vegetation or other matter likely to introduce any insect pest or disease destructive to vegetation;

(b) the terms or conditions upon which such matter may be imported;

(c) for the treatment to be given any vegetation, and may prescribe whether the treatment shall be given by the owner or a person appointed for the purpose;

(d) for the destruction of any vegetation infested or suspected to be infested with pests or diseases;

(e) for the granting of compensation for destroyed vegetation;

(f) for the prohibition of the sale of any vegetation infected with pests or diseases;

(g) that the occupier of premises shall notify the Minister of the presence of insect pests or diseases;

(h) for the confiscation of any vegetation, etc. if any breach of this Act or any legislation made thereunder is committed "and generally for any other purpose which may be deemed expedient for carrying out the Act, whether such other regulations are of the kind enumerated in this section or not".

This is a most important clause and grants very wide powers to the Governor General in Council .

Provision is also made for the Minister to appoint inspectors, for the carrying out of the Act, the right to trespass of Inspectors, the placing of emergency quarantines by the Minister, and the punishment of persons contravening the Act or any regulation.

Since the passage of the Act regulations have been issued from time to time as the necessity arose. The present regulations may be summarized as follows:

All nursery stock entering Canada from foreign countries is subject to either fumigation or inspection or both. Nursery stock from all countries except Europe is subject to fumigation and may enter only through specified ports of entry at certain seasons of the year; such stock is fumigated at one of the federal stations (except in the case of British Columbia where it is treated under the immediate supervision of the provincial authorities), and no stock subject to fumigation may be released from customs unless it is accompanied by a certificate of fumigation.

Nursery stock from Europe, Asia and the New England states is subject to inspection. Every importer of such stock is required to send a copy of his original order to the Dominion Entomologist (except in the case

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3. Report of the Division of Entomology and Botany, Experimental Farms, 1909, page 41.

4. The Destructive Insect and Pest Act, Statutes of Canada, 9-10 Edward VII, Chap. 31.

of residents of British Columbia). Shipments of stock subject to inspection must enter at specified ports of entry and at certain seasons of the year. The shipment is either examined at the port of entry or allowed to proceed to destination in bond, in which case the package must not be opened except in the presence of an inspector.

Restrictions are also placed on the importation of the following products:

The importation of potatoes is prohibited from Europe, Newfoundland, the Islands of St. Pierre and Miquelon, and the states of Pennsylvania and West Virginia on account of the Potato Wart Disease and from the State of California on account of the Potato Tuber Moth.

The importation of all non-canned fruits from the Hawaiian Islands is prohibited, except pineapples and bananas, which have been certified as being free from the Mediterranean Fruit Fly.

The importation of conifers and "Christmas Greens" from the New England states is prohibited on account of the Gipsy moth.

All forest products, quarry stones, etc., from the New England states must be accompanied by a certificate which states that the shipment is free from the Gipsy Moth.

The importation of chestnuts and chinquapins from the United States is prohibited on account of the Chestnut Bark Disease.

The importation of all five-leaved pines and currants and gooseberries (except from the state of New York into the province of Ontario) is prohibited from all countries.

Certain species of the genus Berberis are prohibited entry into Canada on account of the Black or Stem Rust of wheat.

Corn, broom corn, sorghums and certain varieties of cut flowers and vegetables from the areas in the United States infested with the European Corn Borer are not permitted entry into Canada unless they are certified as being free from this pest.

The importation of alfalfa hay from the areas infested with the Alfalfa Weevil in the United States is also prohibited.

There are also four domestic quarantines now in force:

The first restricts the movement of nursery stock from the areas infested by the Apple Sucker in the province of Nova Scotia. The second prohibits the movement of corn from the areas infested by the European Corn Borer in southern Ontario. The third prohibits the importation of certain species of barberries into the provinces of Manitoba Saskatchewan and Alberta. The fourth prohibits the importation of all five-leaved pines and currants and gooseberries into Alberta and British Columbia from the other provinces.

The tremendous growth in international trade and the exchange in commodities of all descriptions which has taken place in the last few years must cause those concerned with insect pest legislation to pause and think as to what is to be the final outcome of legislative control of foreign pests by embargoes and quarantines. Such measures are effective and meet with little opposition in the case of commodities which may be classed as luxuries or at least are not of major importance as regards the general welfare of the nation, but what is to be done if a basic commodity such as wheat or rice is involved? The cotton situation in the United States was met by the vacuum sterilization under government supervision, of all imported cotton and it appears that further investigation along this line with other products is highly desirable. Mackie in California and Sasscer in Washington are pioneers in this work and are accomplishing very gratifying results. But there is another side which should receive due consideration and that is inspection and treatment if necessary, previous to shipping. Many inspectors are of the opinion that they cannot accept certificates other than their own, and rightly so for no inspector is infallible and a double inspection merely serves as an additional check against the importation of dangerous pests.

In 1914 an International Phytopathological Conference was held at Rome, the recommendations (5) made by the delegates to conference included some clauses which if

5. The Recommendations of the International Phytopathological Conference (Rome, Feb. 24-Mar. 4, 1914) Monthly Bull. of Agricultural Intelligence and Plant Disease, International Institute of Agriculture, Year V. No. 4, April, 1914, p. 542.

carried out efficiently would assist very greatly in furthering this idea. Unfortunately the great war soon followed this conference and all such matters were dropped. Foreign entomologists must be made to realize that common pests which may not be regarded as of major importance by them, may prove to be under a different environment a serious pest and of major importance. Last summer the writer visited France, Holland and Belgium. In talking with one of the higher Belgian officials, the question was asked as to what he regarded as the most serious pest likely to be found on plants for export; the reply was the gipsy moth and upon further inquiry it was learned that although this insect was not regarded as a serious pest by the Belgians, it was a very much feared insect on the North American continent and for that reason the Belgian officials endeavoured to impress upon the exporters the necessity of keeping their premises free from this insect.

The future of pest legislation in Canada is a matter that is being given very serious consideration at the present time. On April 21st, 1922, the Destructive Insect and Pest Act Advisory Board was constituted by Order-in-Council; the initial members of the Board are the Deputy Minister of Agriculture, the Director of Experimental Farms, the Dominion Entomologist, the Dominion Botanist and the Chief of the Division of Foreign Pests Suppresson of the Entomological Branch (*).

Canada is in what may be regarded as a fortunate and unfortunate position. Fortunate in that she is not liable to the attack of foreign pests originating in the tropics and unfortunate in that she has not the diversity of climate such as exists in the United States, which will permit her to propagate sufficient quantities of nursery stock to meet her needs.

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*—The members of the Destructive Insect and Pest Act Advisory Board are as follows:

Mr. Arthur Gibson, Dominion Entomologist, Chairman; Mr. E. S. Archibald, Director of Experimental Farms, Vice-Chairman; Dr. J. H. Grisdale, Deputy Minister of Agriculture; Mr. H. T. Gussow, Dominion Botanist and Mr. L. S. McLaine, Chief, Division of Foreign Pests Suppression, Secretary.

Mr. B. Leslie Emslie, C. D. A., F. C. S. has been appointed by the Chilean Nitrate Committee as Director of their educational work in the Dominion of Canada. He has opened an office in the Royal Bank Building, Toronto.

For the past seven years Mr. Emslie has acted as soil fertility specialist for the Dominion Experimental Farms system, and both personally and through his writings is well known to many of our readers. Bringing to his work in the Government service a long experience in the use of fertilizers gained in the British Isles, on the Continent of Europe, as well as in the United States and Canada, Mr. Emslie has, since the year 1915, been responsible for the planning and supervision of all the investigational work with fertilizers conducted on the various experimental farms and stations from coast to coast. He is therefore familiar with the merits of Nitrate of Soda and well qualified to demonstrate its rationable and profitable use.

Nos Connaissances Actuelles sur le Lait

PAR M. LOUIS BOURGOIN.

Ecole Polytechnique, Montréal

(Suite du numéro de septembre)

L'anaphylaxie découverte par Richet, a été signalée comme résultat d'ingestion de lait par Arthus en 1903; ce phénomène a donné lieu à des considérations nombreuses et nous en sommes encore aux théories. (19). Les cas d'anaphylaxie, cette hypersensibilité de l'organisme à l'absorption d'une très petite quantité de lait, sont heureusement rares. Récemment le professeur Weill a trouvé qu'on pouvait faire disparaître par injection sous cutanée de lait ces accidents d'intolérance du nourrisson au lait de vache.

Telles sont, dans leur ensemble, nos connaissances actuelles sur le lait et sa valeur alimentaire. C'est afin de pourvoir à alimentation humaine qu'ont été entrepris les traitements industriels du lait dont nous allons parler maintenant.

Une des premières modifications qu'on crût bon de faire subir au lait de vache fut de lui donner une composition quantitative voisine du lait de femme. Ce fut l'origine des laits humanisés, maternisés. On réduit la quantité trop forte de caséïne du lait de vache par dilution et on augmente la teneur en sucre par adjonction de lactose ou de sucre ordinaire. Plusieurs procédés portant les noms de leur auteur sont employés; je ne m'y attarde pas; ils sont inemployés industriellement ici. La modification la plus commune est la dilution avec de l'eau sucrée qui est pratiquée dans les familles sur le conseil du médecin. Ce que nous avons appris sur le lait depuis dizaine d'années nous fait sourire au vocable de lait maternisé! Il manque surtout à ces laits les lécithines, les phosphates, les albumines du lait humain; les éléments minéraux sont loin d'être dans le même proportion et les diastases ne sont pas les mêmes.

(19) M. Péhu et P. Bertoye: Sur l'anaphylactie lactée; "Le lait" No. 7 1921. Résume les travaux antérieurs, voir également: A. Marfan: Traité de l'allaitment. (Paris 1921).

Nous ne dirons rien des laits fermentés tels que kéfir, koumys, yoghourt et autres; leur consommation est nulle au Canada, non plus que sur les laits dits médicamenteux contenant des citrates, des phosphates, des lécithines, de l'iode ajoutés pour en arriver à l'exposé des procédés de conservation du lait de vache faisant l'objet d'opérations industrielles.

Le lait est une liquide éminemment altérable. Dans la pratique les altérations qu'il subit sont causées par les microbes bons ou mauvais qu'il contient invariablement et qui transforment les éléments du lait, changeant ses caractères chimiques et physiques.

Après les opérations de la traite desquelles dépendent en majeure partie la qualité du lait et so bonne conservation, l'industrie dispose d'un certain nombre de moyens pour prolonger la conservation du lait destiné à l'alimentation dans les agglomérations. Ils visent à ralentir ou à annihiler le développement microbien.

On distingue: le refroidissement et le congélation,

la clarification,
l'électricité et les radiations,
le chauffauge,
l'évaporation,
la dessication,
les antiseptiques.

Refroidissement et congélation—On sait que la vie des microbes, par conséquent leur développement, est très ralentie aux basses températures. Autour de 50F la prolifération des bactéries est assez faible pour que le lait puisse se conserver sans grandes altérations permettant le transport, la livraison et la consommation du liquide. Plus bas est mieux on peut atteindre le voisinage du point de congélation (0,55C) (30°), la durée de conservation est augmentée. Encore plus bas, le lait se congèle et ne revient à son état liquide sans modification que si on a eu soin pendant le dégel d'agiter continuellement la masse pour l'homogénéité du mélange car, pendant la congélation, les

éléments colloïdaux et solubles se sont rassemblés vers le centre.

Le froid ne détruit pas, c'est donc le procédé industriel qui respecte le plus l'intégrité des constituants du lait. Comme il laisse aux bactéries la possibilité de se développer à la faveur d'une élévation de température, il est de toute nécessité que le liquid soit maintenu constamment à basse température. Si le lait n'est pas abondamment contaminé par des germes pathogènes, le froid est toujours, jusqu'à nouvel ordre, le procédé de choix pour la conservation du lait. Il est coûteux, mais il assure un bon lait. S'il est appliqué de bonne heure après la traite et maintenu, le lait ne verra pas ses principes alimentaires entamés par les bactéries, et il sera exempt des déchets indésirables que celles-ci laissent. Le prix de revient sera inférieux à celui du même liquide mal ou insuffisamment conservé et auquel on fera subir d'autres opérations industrielles coûteuses.

Clarification.—Partant du fait que la boue restant dans les centrifuges après l'écrémage contient toujours un grand nombre de bactéries, d'élêments cellulaires et de matières insolubles, on a pensé qu'on pouvait améliorer la qualité du lait faisant subir l'action de la force centrifuge dans des machines à grande vitesse. C'est surtout aux Etats-Unis que des travaux récents nous renseignent sur l'action de la clarification (20) Jusqu'ici les conclusions sont floues, l'avantage de la clarification serait surtout marquée pour les laits recueillis proprement. Quand elle est faite sur des laits riches en bactéries, il semble que la diminution soit nombre apparent de bactéries augmente par peu conséquente et, dans certains cas, le suite, pense-t-on, de la division des amas.

La clarification demeure un procédé accessoire qui peut rendre de grands services en débarassant le lait tout de suite après la traite des impuretés et des amas de bactéries on réduit beaucoup et mieux que par le coulage la contamination initiale qui est la plus importante et aucune modification n'est apportée au liquide. Cette opération étant cependant coûteuse ne peut se faire que dans les grandes exploitations.

Electricité et radiations.—La destruction des bactéries par l'électricité n'a pas donné jusqu'ici de résultats bien avantageux. Seuls les courants alternatifs amoindriraient le nombre de bactéries sans altérer les composants du lait. Cependant un contact trop prolongé avec l'électricité développe un goût de cuir bouilli inacceptable, sans doute dû à des combinaisons avec l'ozone produit.

Les radiations, particulièrement les radiations ultra-violettes dont l'action stérilisante est maintenant utilisée dans le traitement des eaux de boissons, peuvent être appliquées à la stérilisation du lait. Le principal obstacle, qui disparaîtra un jour devant des perfectionnements techniques, est l'opacité du lait aux rayons ultra-violets. Il faut de toute nécessité opérer en couche mince, ce qui réduit le débit qui devient trop faible pour que le procédé soit acceptable par l'industrie.

L'avantage de ce procédé, qui pour moi est appelé à un certain avenir, est qu'il ne modifie pas le lait en donnant une stérilisation complète. Il a pour inconvénients que le temps d'exposition minimum pour détruire est variable avec les espèces microbiennes et qu'on ne peut prolonger l'action des rapons, ce qui d'ailleurs ne serait pas avantageux, sans altérer les vitamines. D'après des travaux récents elles disparaissent dans le beurre après plusieurs heures d'exposition détruites par l'ozone que forment les lampes à vapeur de mercure au contact de l'air.

Chauffage, Stérilisation, Pasteurisation, Ebullition.—De tous les moyens de conservation du lait, la chaleur est aujourd'hui le plus répandu.

La stérilisation, qui a pour but de détruire tous les germes vivants en portant le lait à une température supérieure à 100C (212) dans des appareils spéciaux où elle est maintenue quelque temps, a semblé être la solution idéale du problème de la conservation et de la destruction des bactéries pathogènes du lait. Au point de vue technique, elle n'est pas sans difficultés mais on a pu les surmonter et livrer au commerce des laits stérilisés répondant bien à la définition de

(20) T. J. McInerney: *Clarification of Milk, Cornell University Agricultural Experimental Station Bul:* 389-1917.

Ch.-E. Marshall & E.-G. Hood: *Clarification of milk etc..Massachussets Agricultural Expe. Station Bull. No.* 187, 1918.

pareils produits. Recommandé sans réserve voilà quelque vingt ans, l'emploi du lait stérilité pour l'alimentation des enfants n'a cessé de décroître; on ne doit pas l'employer sans le contrôle du médecin. Nous avons appris par les accidents qu'il a causé, par les découvertes nouvelles sur la composition du lait, pourqoui le lait stérilisé ne mérite plus l'étiquette d'aliment recommandable pour tous qu'on voulait trouver en lui. D'une liquide vivant la stérilisation fait un liquide mort. Voulant détruire les mauvaises bectéries on tue les bonnes, on fait disparaître les lécithines, on disloque les albumines, on altère les phosphates, les citrates; les diastases et les vitamines ne se trouvent plus. Si la stérilisation ne porte pas sur un liquide frais, pauvre en bactéries on s'expose à compter comme inoffensif un liquide empoisonné de toxines bactériennes que la chaleur n'a pas détruites. Exposé à l'air le lait stérilisé se putréfie très vite; ce qui oblige à réduire la capacité des récipients occasionnant des dépenses qui, ajoutées à celles de la stérilisation, mettent le lait stérilisé dans la classe les aliments chers.

En regard de ces inconvénients le lait stérilisé industriellement par chauffage 30 minutes à 110°C (230F) dans des bouteilles afin d'éviter la contamination des transvasages, n'offre qu'un seul avantage: celui d'être privé de bactéries vivantes, en admettant l'opération bien faite. Si le lait a été homogénéisé à la machine pour empêcher la séparation de la matière grasse, il ne recouvre aucune des propriétés alimentaires qu'il a perdues, seule sa digestibilité est accrue par suite de l'état de division des globules gras.

Loin de moi la pensée d'être en principe contre un procédé de stérilisation qui respecterait toute l'intégrité du lait et détruirait d'une façon certaine les bactéries pathogènes qu'il peut véhiculer. La science n'a pas dit son dernier mot, il semble qu'elle ne doive jamais en avoir, et si j'estime qu'on doit se montrer en pratique plus prudent qu'on l'a été dans cette question du lait, je suis heureux de signaler un nouveau procédé stérilisant le lait par la chaleur sans altérer aucunement ses propriétés ne le privant pas de ses vitamines. C'est le procédé que le Dr. Stassano étudie à l'Institut Pasteur de Paris. (21).

Partant de cette constation que la destruction des vitamines est plutôt fonction du temps que du degré de chauffe, on porte le lait en couche mince à une température de 130C (266F) pendant 15 secondes. C'est le coup de poing d'un bon boxeur sur notre indésirable bactérie, elle ne s'en relève pas et les constituants normaux n'ont pas eu le temps de changer de face, l'affaire est terminée. Le lait n'est pas affecté, il caille sous l'action de la présure comme le lait frais, ce qui est un des meilleurs témoignages que rien n'est modifié de son harmonie. Il faut attendre que l'Ecole de Puériculture qui poursuit des travaux ait prononcé son verdict; il faudra ensuite l'expérience de quelques années pour juger de la réelle valeur du lait stérilisé ainsi obtenu, et il serait imprudent dans une loi de condamner ce procédé par le fait qu'on en définit un seul autre avec trop de précision.

La pasteurisation constitue une demi-mesure. Elle s'est surtout répandue quand on s'est apperçu des méfaits de l'alimentation trop exclusive au lait stérilisé. En principe, elle consiste à porter le lait à une température assez basse pour modifier le moins possible le liquide et assez haute pour détruire un grand nombre de bactéries et toutes les espèces pathogènes. Industriellement nous disposons de quatre procédés principaux: 1° la pasteurisation haute où le lait est soumis pendant 2 à 3 minutes à 80-95° C (176-203) 2°la pasteurisation basse, où le lait est porté pendant 30 minutes à 60-70°C (140-158); 3° la pasteurisation en bouteilles par chauffage au bain-marie; 4° la "biorisation" ou on porte le lait brusquement à 75° C (167) en le pulvérisant dans une enceinte chaude. (22).

Chacun de ces procédés ont leurs partisans; ils ont tous des avantages et des inconvénients. La différence essentielle entre les procédés est que pour les uns la température est élevée le temps étant minime, pour les

(21) E. Rousseau: *Les nouvelles methodes de sterilisation du lait* 1er *Meeting de la Chimie Industrielle.* (Paris 1921).

(22) Orla Jensen: *La pasteurisation du lait*: *Le lait* Nos 3 et 4 1921. Resume des differents procedes. Van Laer: *La pasteurisation du lait*: Meeting *de la chimie industrielle* Paris octobre 1921.

autres la température est basse mais elle agit longtemps. Au point de vue industriel il est plus commode de chauffer haut et faire vite, au point de vue microbien les procédés sont à peu de chose près équivalent. La pasteurisation offre sur la stérilisation l'avantage de ne pas modifier le goût ni la couleur du lait et de respecter un peu mieux sa composition chimique, physique et biologique.

Cependant, il y a quelque chose de changé par rapport au lait cru. Le lait pasteurisé ne caille pas de la même façon, les lécithines sont en partie détruites, de l'albumine est précipitée et cela d'autant plus que la température a été plus haute, les diastases sont à peu près disparues et on n'est pas certain que toutes les vitamines soient présentes, les enfants nourris au lait pasteurisé seraient plus sensibles au scorbut que ceux alimentés au lait cru ou bouilli. D'autres choses nous échappent-elles? Il est permi de se le demander. Le fait qu'un palais habitué distingue le lait ru du lait pasteurisé, le fait aussi que nos réactifs chimiques nous indiquent sûrement si un lait a été chauffé, la différence du caillage, prouvent qu'il y a réellement quelque chose de changé.

La pasteurisation ne détruit pas toutes les bactéries mais la préoccupation dominante des hygiénistes mais la préoccupation dominante des hygiénistes qui la préconisent est la destruction du bacille tuberculeux.

Or l'accord n'est pas complet entre les auteurs sur la température de destruction du bacille tuberculeux; des hygiénistes se montrent satisfaits avec un chauffage de 30 minutes à 62°C (142F), alors que pour d'autres il faut ou bien l'ébullition pendant 2 à 3 minutes ou bien des températures de 85°C (185F) maintenues 2 à 3 minutes, 75°C (167) une demi-heure, 68°C (154F) une heure. Ces résultats discordants doivent faire réflichir et c'est pourquoi le professeur Marfan (23) conclut sur cette question: "Le moyen le plus simple et le plus sûr consiste à bouillir ou à stériliser le lait destiné à l'alimentation surtout des jeunes enfants".

Dans la pratique d'une pasteurisation ordinaire bien faite la formation d'une mousse, même avec une bonne agitation, protège le bacille contre l'attaque de la chaleur. Beaucoup d'hygiénistes ont été déçus de voir persister le bacille tuberculeux dans des laits pasteurisés d'une façon satisfaisante dans l'industrie. Mais si la chaleur parvient à tuer le bacille est-ce que le liquide où il a vécu est complètement privé de propriétés nocives? Les auteurs répondent non, le lait contient des toxines capables de causer des accidents et surtout d'aggraver une infection commençante. On doit donc plutôt s'orienter vers l'élimination des animaux franchement tuberculeux pour la production du lait et vers le mélanges des laits de plusieurs vaches quand on a des doutes afin de réduire les dangers au minimum. L'inspection des laiteries faites seulement par des vétérinaires permettrait à ce point de vue plus d'efficacité.

On reproche à la pasteurisation d'être une pratique trompeuse, on lui reproche aussi de masquer les altérations des vieux laits en permettant de fournir à la consommation des liquides répondant bien aux exigences de l'hygiène quant à la quantité de bactéries mais pleins de toxines, de spores, et déjà à demi consommés par les microbes.

Je sais qu'on va me demander si je suis un partisan de la pasteurisation. Je me permettrai donc d'exprimer mon opinion personnelle sur cette grave question.

Je suis contre la pasteurisation *obligatoire* telle qu'on la conprend aujourd'hui, il y a mieux à trouver. Actuellement, à quoi la conprend aujourd'hui, il y a mieux à trouver. Actuellement, à quoi bon le cacher, la pasteurisation pour le lait destiné à l'alimentation aide plus aux industriels qui la pratiquent qu'au public pour qui les hygiénistes la réclament. Elle serait bien supérieure si elle était pratiquée dans un bref délai après la traite plutôt que sur des mélanges de lait de qualité variable. Pour les jeunes enfants, le lait pasteurisé donne aux mères une fausse sécurité. Le plus grand nombre pensent que l'*étiquette* lui confère des qualités de pureté et qu'on peut négliger les soins de conservation et de propreté du lait à la maison; "il est pasteurisé". Je suis d'avis qu'il ne faut pas s'effrayer outre mesure de la présence possible du bacille tuberculeux boivin dans les laits commerciaux: le mélange des laits industriels assure une dilution suffisante aux bacilles qui malheureusement peuvent se trouver dans un ou plusieurs laits pour que l'ingestion de laits faiblement bacillifères ne soit pas tellement dangereuse.

(à suivre)

(23) A. Marfan: *Traite de l'allaitment*, Paris 1920, page 159.

The Adult Habits of the Apple Sucker

(*Psyllia mali Schmidberger*)

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The apple sucker accomplishes most of its damage during the nymphal stage and attention has been therefore chiefly focused on this stage. In studying any insect of economic importance, however, no stage should be neglected and for this reason, rather careful records have been and are still being kept regarding the adult life of the pest.

Like the nymphs the adults are tolerant of bright sunlight. When a limb, the undersides of the leaves of which shelter numerous adults, is broken off, held in the light of the sun and reversed, the insects move around to the upper surface and back again when the operation is completed. In high shade trees the adults are found fairly plentifully well up in the tree, but are not so numerous as on the lower limbs.

The relative activity of the adults is apparently dependent on temperature and on sunlight. During warm days they jump rapidly and take to flight at the least disturbance, the progress of a person through a badly infested orchard being accompanied by a constant patter of arising adults. Under certain conditions, however, they remain immobile for considerable periods. In October a single individual remained in the same position on a leaf for seventy-two hours. The degree of activity seems to be influenced directly by warmth; the higher the temperature the more easily are the insects disturbed.

Repeated observations made at different hours of the night indicate that at this time they are particularly immobile and very hard to disturb. Subjecting them to the direct glare of an electric torch for five minutes at a time fails to rouse them to any activity. Even when the limb upon which they rest is violently shaken they move only reluctantly and the familiar patter of arising adults is almost entirely absent. When disturbed by spraying or dusting operations, they may be seen rising in a cloud from the infested trees. They appear to have a strong capacity for flight, being able to return to their original resting place when shaken off, even against a fairly strong breeze. In fact they are sometimes quite persistent in returning to their own tree when their sudden flight combined with the wind has carried them almost into the adjoining row of trees. It would not appear, however, that of themselves, they would fly far from their place of origin, but it seems equally certain from the manner of their spread that they may be blown considerable distances by the wind.

The adults show a tendency to cluster together on the undersides of the leaves. As many as forty-five have been observed on a single leaf. The adults do not feed extensively as do the nymphs and their work is free from the profound effects exerted upon the infested trees by the immature insects. The secretion of honey dew is, correspondingly, less copious and is clear and colorless.

Relative Numbers of Males and Females.

Counts, taken at random, were made at intervals throughout the season in 1921 to determine the relative abundance of the sexes at different periods. The counts indicate that, as would be expected, the number of females increases in proportion to that of the males as the season advances.

Date Counted	Percentage Females	Percentage Males
July 7	49	51
Aug. 4	37	63
Aug. 17	43	57
Sept. 5	58	42
Sept. 23	63	37
Oct. 30	74	26

Migration and Distribution.

There appears to be partial migration of adult apple suckers from infested orchards and a later return migration. In 1921 there was a very noticeable diminution in the numbers of the insects in infested orchards beginning in the third week in June and continuous for about one month, when their numbers again began to increase. Examination of neighboring trees, shrubs and even

tall herbaceous weeds revealed the presence of the insects in considerable numbers. The following is a list of plants from which collections were made:

Willow	Elm
Swamp Willow	Chestnut
Sugar Maple	Currant
Alder	White Birch
Blackberry	Beech
Spruce	Quaking Aspen
Wild Cherry	Broad Leaved Poplar
Shad Bush	Hawthorn
Sweet Fern	Raspberry
Dogwood	American Mountain
Rose	Ash.
Ash	

Unfortunately we were unable to make actual records of the relative abundance of the insects in the orchard and on surrounding or remote vegetation until August 1st. At this date they were still fairly numerous on trees in immediate proximity to the orchards, but diminished rapidly as the distance increased. They were at this time only numerous on the borders of woods. Woodlands are very thickly grown in this region and a small area would soon absorb a very large immigration from nearby orchards.

For determining the relative abundance of the insects at different periods, three different type localities were selected:

1. Apples and plums in a heavily infested orchard.
2. Woodland and shade trees in the fence row of above orchard.
3. Woodland trees about one quarter of a mile from orchard.

In attempting to select a method for securing an accurate estimate of the actual numbers present in these different localities, we met with considerable difficulty owing to the great activity of the adult insect and its tendency to take to flight at the least disturbance. We finally settled on the practice of counting as many insects as could be observed in a period of five minutes. In order to minimize as far as possible the errors arising from differences in visibility, etc., the work was all done at the same time of day and an average of three different counts was taken. While this method is obviously far from satisfactory, it does serve to give a general idea of the condition that actually exists. More exact methods have been put into effect this season, but the results from these are not yet available.

The following summary (Table No. 1) gives the broad outlines of our results. Here we have added together the counts from the trees from the three type locations, this massing of figures tending further to reduce experimental error and to give us the needed information in concise form. The details of our observations are shown in table No. 2.

TABLE NO. 1

Total No. of *P. mali* seen in Three Different Locations on Different Dates.

Date of Counting	Apple in Orchards	Increase or decrease from previous date.	Forest trees bordering Orchards	Increase or decrease from previous date	Forest trees ¼ mile from orchards.
Aug. 1.	161		481		16
Aug. 9.	321	+100%	424	—12%	35
Aug. 21.	271	+16%	191	—55%	8
Aug. 31.	205	— 24%	76	—61%	4
Sept. 10	120	— 41%	6	—92%	0
Sept. 20.	150	+25%	22		0
Oct. 1.	178	+18.66%	1.		0

NOTE:—The above digest is merely for comparison of percentages, and not of numbers of the insect; those in columns headed "Forest Trees" are massed from 10 trees, while the numbers under "apple in orchards" are the total seen on 2 trees only.

From an examination of the figures presented it will be seen that on August 9th the infestation on the apple trees had increased 100%, whereas the number of insects on the forest trees had declined, showing a reduction of 12%. On August 21st, the numbers on apples also began to decrease, viz., 16% but during the same period on the forest

TABLE NO. 2

Showing Infestation in Orchards and Neighboring Woods on Different Dates.
No. of Apple Sucker Adults seen in 5 Minutes

Variety	Aug. 1	Aug. 9	Aug. 21	Aug. 31	Sept. 10	Sept. 20	Oct. 1	Oct. 11	Oct. 21.	Location
B. Pippin	61	81	57	50	40	60	86	98	81	Orchard
Blenheim	50	240	214	165	80	90	92	89	74	Orchard
Plum	104	213	84	22	7	3	2	0	0	Orchard
Oak	109	100	40	13	0	0	0	0	0	On fence line bordering above orchard
Poplar	17	45	10	8	0	1	0	0	0	"
Birch, white	41	65	21	7	0	0	1	0	0	"
Spruce	49	33	16	3	0	3	0	0	0	"
Alder	4	40	10	5	1	3	0	0	0	"
Maple	6	21	15	3	0	0	0	0	0	"
Spruce	7	2	0	0	0	0	0	0	0	100 yds. from orchard
Wild cherry	33	23	9	0	0	0	0	0	0	Alongside orchard
Ash	175	60	37	16	0	12	0	0	0	"
Ash, mountain	77	37	33	21	5	4	0	6	2	"
Poplar	0	2	0	0	0	0	0			About ¼ mile from orchards
Spruce	2	5	1	0	0	0	0			"
Maple	12	12	6	3	0	0	0			"
Alder	1	15	0	1	0	0	0			"
Birch white	1	1	1	0	0	0	0			"

trees there was a much greater proportional decline. By September 20th. there was further increase on the apple trees of 25%, whereas the actual infestation on wild trees is of insignificant proportions. The comparatively large number on ash at this date, which greatly augments the percentage increase, may well have been due to a chance cluster on this tree. The numbers present on the wild trees are so small that the actual figures are here more instructive than the percentages. It will be seen that the insect is apparently most persistent on the American Wild Ash. Even as late as October 21st, the date of our last count, there is a comparatively high count on the apple, while but two individuals were found on Mountain Ash. The numbers involved in the trees remote from the orchard are too small to be taken into account.

While figures are not available for the period prior to August 1st, it seems to be established that there is an outward migration from the orchard to neighboring wild trees and a later return migration to the orchard.

Observations made during the past season with several other species of *Chermidae* would indicate that this habit is quite general for members of this family. There is, of course, a considerable mortality among the adults both in the orchard and on wild trees due to factors which may be conveniently referred to under the heading of "natural control". How far this may account for the apparent "ebb and flow" of the insect in the orchard, or how far this apparent rise and fall may be due to the manner in which our counts were taken, or how far to other causes, can only be settled by an enormous amount of careful observation, not yet carried out.

Rate of Re-infestation.

For an orchardist who has this pest to contend with, it is a matter of great practical importance for him to know to what extent and how rapidly his orchard is likely to be reinfested from adjoining untreated orchards. To test this point several blocks of orchard were selected designated A, B. C. D. E. F, G and H, in the accompanying table (No. 3),

TABLE No. 3.

RATES OF REINFESTATION

No. of P. Mali seen in 5 Minutes—Average of 3 Counts Taken

Method of Control	Material	Block	Date Applied	No. seen prior to application	No. seen after application	Aug. 13		Aug. 23		Sept. 2		Sept. 12		Sept. 22		Oct. 2		Oct. 12		Oct. 22	
						Treated	Check	Treated	Check	Treated	Check	Treated	Check	Treated	Check	Treated	Check	Treated	Check	Treated	Check
Spray	Nicotine Sulphate 3%	A	8/8	89	35.0	2		11		8	31	6	28	5	31	6	17	7	14	5	10
Dust	Nicotine Sulphate	B	8/8	122	2.3	2		7		12	40	15	23	24	30	10	15	6	17	6	14
Fumigation	Nicotine Sulphate & Tobacco Stems 3%	C	9/8	85	1.0	1		9		17	25	9	28	14	31	7	17	11	14	8	10
Dust	Nicotine Sulphate Pyridine	D	12/8	100	2.	2		13		33	40	22	23	14	30	14	15	16	17	11	14
Fumigation	& Tobacco Stems	E	10/8	144	9.	14		32		71	117	48	82	62	92	42	53	41	44	32	31
Fungus		F				30		25		21		15		17			17	14		8	
Fungus		G				30		30		18		15		12			14	10		5	
Spray	Lime Wash	H				40	80	36	70	46	55	67	58	70	59	70	49				

NOTE: On September 2nd, as there seemed to be a diminution of infestation in Check H, counts were also commenced in the other blocks, as shown in columns under this and subsequent dates.

In two of these blocks, viz., F. & G., the insect had been almost exterminated by a fungous disease. (*Entomophthora sphaerosperma*) the previous season. Orchard F was not only completely freed of the pest, but it is surrounded by an orchard in which the insect was similarly wiped out. Hence it offered ideal conditions for observations with respect to the matter of reinfestation.

In the other blocks the insects were destroyed or their numbers reduced by spraying, dusting or fumigating. Exact details of the treatments applied are given elsewhere, as they do not interest us at this point. Blocks A, B & D. consisted of three rows of trees, thirteen trees to the row with infested parallel rows on either side. Block C was double this size, the counts being made from the two inside rows. The nearest untreated trees to this block were separated by a distance of thirty feet. It should be noted that the pest was practically exterminated by the treatment given to this block. Block E consisted of three rows of trees five to the row, surrounded by heavily infested trees. Block H. consisted of a block of approximately two acres; counts were made at the centre of the block. This block had been treated in early spring with heavy lime wash and later by contact sprays, cutting down the numbers of the pest to a minimum. We were thus in a position to take records from areas of a fair size as well as from small blocks where the opportunity for ready reinfestation was very much greater.

With the exeption of the fungous plots, where the entire area was freed of the pest, counts are also given in the table (No. 3) from an untreated part of each block. Such counts were only made for the first two periods, viz., on August 13th and August 23rd, on Block A, but, as our count of September 2nd showed that the numbers of the insect in the untreated part were diminishing, we began with that date to make similar counts from the other blocks. In making the counts the same method was followed as that previously described.

Our table confirms to some extent our observations made in discussing the question of the migration from orchard to wild trees and back again, viz., that the *Psyllia* population in the same orchard does not remain stationary throughout the season. On September 22nd in Block E, 92 insects were counted in comparison with 82 ten days earlier, and in block H (check) the counts are 59 and 55 respectively for a twenty day period. These differences are not striking, but they occur in widely separated orchards, and at a period when we would have expected a decline due to natural causes. There has not been, however, the same equalizing effect that might have been anticipated on such small blocks as A to E. By adding together the figures for September 2nd from all these blocks we secure a figure of 141 on the treated compared with 253 on the checks, which amounts to a reinfestation of 36% of that on the checks. Contrary to what might be expected the reinfestation did not continue at the same rate on the five blocks, for the count of September 22nd. gives us 119 individuals on the treated plot against 214 on the checks, which, though a decrease in both cases, gives the same ratio between treated and checks. On three plots, viz., C. D. & E. the counts on treated and checks are approximately even at the end of the season.

On Block H there was a much longer time allowed for reinfestation, since the treatment was given in the spring and there was an opportunity for the drift to set in from the beginning of the adult period, whereas the other treatments were not given until August. The counts on September 2nd show 46 on the treated compared with 55 on the checks and all the subsequent counts show more on the treated than on the check rows.

The counts in orchards F. and G, where the pest had been wiped out by fungus the previous year, shows that by the time egg laying started there had been a sufficient drift back into these orchards to produce a serious infestation for another year. The decline in numbers which is noted in these plots is doubtless due to natural causes.

It seems quite plain that where the pest has been controlled during the early part of the season in any orchard, unless the particular orchard is an isolated one, a sufficient influx of new individuals from neighboring untreated orchards may occur during the summer and fall to reinfest the orchard for the following year. Should some method be employed and generally adopted for destroying the adult insects late in August before oviposition commenced and over a large area, this very bad feature might be overcome, but the bringing of such a scheme into effect is beset with many difficulties.

Mating Habits.

During copulation the males and females are found lying alongside one another. The two pointed terminal segments of the female are pointed abruptly ventral.. The last abdominal segment of the male, which normally projects dorsad at right angles from the body, now projects cephalad, under the eighth addominal segment of the female, while the trough-shaped subgenital plate, together with the cephalo-dorsad projecting claspers, surround the dorsal plate of the female.

According to Witlaczil * (1885), in *Psylla buxi*, the two-jointed penis of the male lies up to the joint in the trough-shaped seventh (eighth) segment of the female, so that its apex extends into the vagina of the female up to the efferent duct of the "spherical" glands. Since the opening of the penis lies upon its upturned side, the seminal fluid may be injected into the seminal receptacle.

Egg Laying Habits.

The eggs are laid on the smaller twigs, first spurs or shoots, also, strange to relate, upon fruit stalks and on leaf petioles just inside the point that they break off in the fall. Though sometimes placed on a larger limb at the base of such shoots, the great majority are on the smaller twigs. The eggs are not laid with any regularity, but occur with great frequency on the unevenesses of the spurs such as the bud-scale scars and many are found among the pubescence of the young growth or even directly on the bud. In severely infested orchards the twigs, during the dormant season, appear to be covered by a reddish dust. As many as eighty-five eggs have been counted in the immediate vicinity of a single bud.

For the purposes of oviposition the adults prefer older trees of bearing age. Occasionally, however, they may be laid on younger trees or even, though much more rarely, upon nursery stock. It is in this fact, however, that danger exists of introducing the pest into new localities, another possible source being infested bud sticks.

Prior to oviposition the female wanders around dragging her ovipositor over the surface inserting it into every crack and crevice until she finds a place which meets with her approval. Some were observed manoeuvering around for as long as fifteen minutes. before actual oviposition commenced and others were kept under observation for even longer periods without result. During the process the insect remains motionless except for an occasional moving of its antennae.

From three to thirteen minutes are consumed in actual oviposition, with periods of rest between each act. On September 16th, one individual was observed to deposit five eggs commencing at 2 P.M. and completing the oviposition of the last at ten minutes past three, the actual time consumed being 9, 3, 11, 5 and 3½ minutes respectively. The longest time observed for the completion of the act was thirteen minutes.

(*) Die Anatomie der Psylloden. Zeit. Wiss. Zool., 42: 569-638.

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BE A BOOSTER.

The Royal Winter Fair is the direct result of demands made by stockmen and representatives of other agricultural interests extending over a long period of years. The need for a big winter exposition, National and International in scope, bringing together the best that this country produces in horses, in cattle, in sheep, in swine, in poultry, in dairy products, in fruit and vegetables, in seeds and in horticulture and flower display, in keeping with the progress and development of agriculture in Canada, has been recognized for many years. It has taken time and the best thought of the leading stockmen, farmers and citizens generally to work out the idea and bring it to a successful conclusion. That has been done in a very effective way, and the ideas and wishes of breeders and exhibitors of Pure-bred and Market live stock, of the producers of Dairy Products, of the Horticulturists and Flower Grower, and the producer of seeds, and other allied interests, have been crystallized into one big undertaking in the exhibition line—*The Royal Agricultural Winter Fair.*

In stimulating interest, in encouraging exhibits, and in assisting to make the show fully successful, the professional agriculturists can be of great assistance.

A Preliminary Study of the Problem of Freezing in the Septic Tank System of Sewage Disposal.

BY R. R. GRAHAM.

Associate Professor of Physics, Ontario Agricultural College, Guelph, Ont.

As there was no definite information available to give in answer to the often occurring question, "will not the septic tank and the tile freeze up in the winter," we decided last fall to initiate some experimental work in order to solve this problem. We were unable to find any definite information, particularly for Canada, so we believe that the investigation undertaken is absolutely new. We look upon the work of last winter as only preliminary, and we have made arrangements to continue it next winter and even longer, if it is necessary, in order to fully solve the problem. The records submitted herewith were taken in connection with the septic tank system at the Physics Building, as it seemed to be about the only one available at the time and sufficiently convenient, but next winter the thermometers will be installed on systems at private homes largely where we will get conditions more representative of those met with generally throughout the rural district in which many of these systems will be installed in the future.

For two or three reasons the system under test last winter did not represent the conditions under which these tanks usually operate. Firstly, the lavatories in the Physics Building of the Ontario Agricultural College are much larger than in a private home, and the urinals are equipped with automatic flushing systems, hence a much larger volume of water passes into the tanks daily than in a private home, probably with the result of lowering the average temperature in the tanks and interfering with the action of the bacteria on the raw sewage; secondly, the tile of the absorbtion bed was 2 feet deep, somewhat deeper than we recommend; and thirdly, the winter was less severe than usual. One or two other conditions peculiar to this installation, which may have had some influence on the results were: that the tops of the tanks were not at all specially protected, the manhole covers being only 1-inch boards loosely jointed, and the tile was laid in heavy soil with a rather wet and cold bottom. There was not more than 6 or 8 inches of snow over any part of the absorption bed at any time during the winter.

We are of the opinion that the septic tank system in connection with a private home would show, under tests, higher temperatures than those obtained in this system, provided that the system was properly installed, the top of the tanks covered with a few inches of soil or coarse manure, or straw, and the tile laid about 16 inches deep in a well drained soil. The depth of the snow covering and the time the snow comes in the fall will always have a great influence on the temperature in the tanks and in the tile system. Therefore, locality as well as minimum temperatures will be a factor of some importance. It is true that there are many conditions that will influence the temperature existing in the tanks, and in the tile, and localities vary greatly in conditions, but we believe that we can secure sufficient temperature data in systems to enable us to decide fairly well, under any particular situation, whether the system would require special protection in the winter or not if we were familiar with the soil and its drainage, the topography of the districts, the snowfall and the minimum temperature.

The Method of Experimentation.

The instruments used last winter in securing the temperature data given herewith were two bi-record recording thermometers, one installed over the septic tank (Fig. 1), and the other over the absorption bed with one bulb down in the tile 2 feet below the surface and the other bulb above the ground 3 feet taking the air temperature (Fig. 2).

As these instruments are well known to scientific workers it is not considered necessary to describe them in particular. Fig. 3 illustrates one day's record taken by the instrument over the tanks, and Fig. 4 that of the one over the absorption bed. It would be more convenient to use instruments with 8-day clocks as then the charts would need to be changed only once a week, but we had the 2-day clocks on hand and had to use them because we could not afford to buy new ones then, but we will probably require more instruments for the work next winter and any new ones will be provided with 8-day clocks.

Some difficulty was experienced with the clocks stopping on very cold days owing to the oil on the works becoming congealed. In using them again we would install an

Figure 1

electric bulb inside the casing. In addition to the two recording thermometers we had three ordinary soil thermometers inserted in the soil over the absorption bed; one directly over the tile in which the recording thermometer was recording but only 1 foot deep, the other two midway between two rows of tile, one 2 feet deep and the other 1 foot deep. These were read occasionally, and the results show that the temperature of the soil at 1 foot depth over the tile was about 2 degrees warmer than the soil at the same depth midway between two rows of tile, and about 2 feet away, thus showing that the higher temperature in the tile had an influence on the soil directly above the tile, and the temperature in the tile was 5 degrees or more higher than that of the soil at the

Figure 2

same depth midway between the rows of tile. We feel that we need more data on this phase of the work before making any definite conclusions, and it will be secured on further investigation.

Results from Recording Thermometers.

The complete records from the two recording thermometers are given in the accompanying table, and by the set of charts (Fig. 5.)

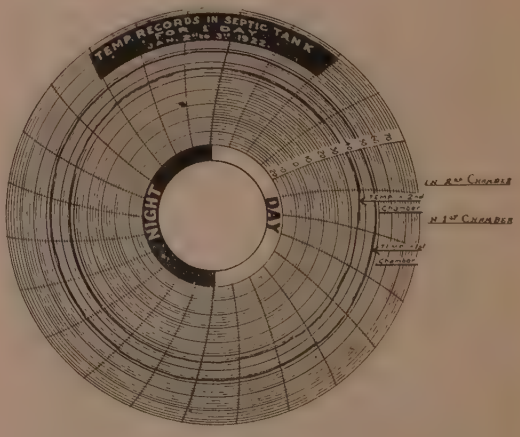

Figure 3

SUMMARY OF TEMPERATURE RECORD S TAKEN IN SEPTIC TANK & ABSORPTION BED.

Months.	Air Temperature. Ave.	Highest	Highest Ave.	Lowest	Lowest Ave.	Temp. in Tile 2 feet deep. Ave.	Highest.	Highest. Ave.	Lowest.	Lowest. Ave.
Dec. —	22.0	42	38	-4	6.5	39.4	44	43	34	36.5
Jan. —	16.8	37	27	-5	3	39.3	44	42.5	35	37
Feb. —	21.1	37	35	-6	3	40.8	44	43	37	39

Months.	Temp. in 1st Chamber of Tank. Ave.	Highest	Highest Ave.	Lowest	Lowest Ave.	Temp. in 2nd Chamber of Tank. Ave.	Highest.	Highest. Ave.	Lowest.	Lowest. Ave.
Dec. —	52.9	60	59	46	47	44.3	55	53	35	37
Jan. —	52.6	71	60.5	44	47.5	42.3	56	53.5	34	35.5
Feb. —	52.8	58	56	48	51	46.5	52	51	42	43.5

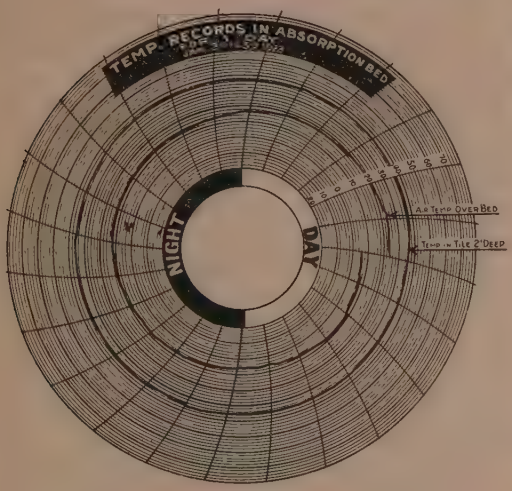

Figure 4

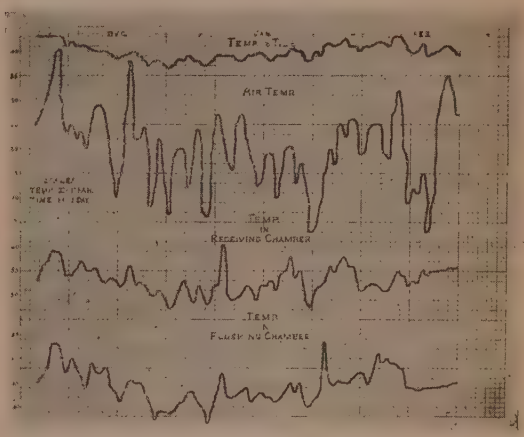

Figure 5

Both the table and the charts are quite self-explanatory, but a few comments as a general summing up may be made with some advantage. These are:—the average air temperature for the 3 months was approximately 20°Fah., the average temperature in the tile about 40° Fah. or 20° higher than the air, that for the receiving chamber about 53° or 33° higher than the air, and that of the flushing chamber 44° or 24° higher than the air. For the whole period there was a range of 52° in the air temperature, 10° in the tile, 27° in the receiving

chamber and 22° in the flushing chamber. The lowest temperature in the air was 6° below zero Fah., in the tile 34°, in the first chamber 44°, and in the second chamber 34°. The effect of the heat generated by the bacteria in the first chamber is very pronounced and also it is worthy of note that the tile temperature is very similar to that of the temperature in the second chamber, thus showing that if the tanks were kept well covered you could control the temperature in the tile to a large degree. If the absorption bed were also covered, say with 6 or 8 inches of straw, it would seem reasonable to believe that the temperature in the tile could be maintained at a very safe point even in the coldest weather.

In our next tests we will cover part of the bed with straw and leave part uncovered, and get records of temperature in the tile under each section. We are looking forward with much interest to further investigation of this problem and trust that one year hence we will have more information available for publication.

In conclusion we wish to say that we have found this a very interesting problem so far as we have gone but that we believe that there is still a great deal of valuable information yet to be secured before we can consider the problem thoroughly solved. The work will be continued next winter. At present we are of the opinion that if the tank and the absorption bed are given a protection of six or eight inches of straw or litter during the winter, there should be no trouble with freezing even in the colder parts of the country.

A gentleman from Muskoka Lakes writes us as follows in regard to this problem :

"I have just received the Annual Report of the Agricultural and Experimental Union. On page 35 there is an article on Sewage Disposal in which you mention that you are endeavouring to obtain data in reference to use of septic tanks in winter. I may be able to be of some assistance to you in this matter as I have had considerable experience in installing septic tanks, having built the first on the Muskoka Lakes and later put in over 100 under all possible conditions, on rocky islands where it was difficult to find sufficient tiling ground among rocks, and in solid hard pans where trenches for tile had to be filled with gravel and from the smallest tank suitable for a small family to hotels accommodating 200 guests, and several of these including my own for use during the winter. I had not had any trouble with these. In my own case the tank has been opened only three times in over ten years, and the tile relaid once two years ago. The test in my case has been particularly severe as for the last two winters my house has been unoccupied during the winter, but each spring the plumbing has been connected up and the tank has resumed its functions without any trouble whatever. Our winter climate as you probably know is exceptonally severe, but in no case have I ever heard of any trouble. The tank should if possible be under ground or, if that is difficult should be mounded up with earth and have a cement top covered with earth. The water going into the tank is always more or less warm and the chemical action of the sewage has also some influence I think."

Later in reply to our answer to his first letter he writes in part as follows:—

"Your letter giving temperatures at various points in the sewage system interested me very much as I never had the means or opportunity of obtaining such information, but I knew that the system worked perfectly during the winter. I think we have rather the advantage of you in this respect for although the temperature is probably very much lower than at Guelph, sometimes falling to 35° and even 40° below zero, the early snowfall is a protection and the ground here seldom freezes more than a few inches, and in many winters does not freeze at all and we can usually depend on digging through the snow and finding unfrozen soil at any time during the winter if we need it. We never give any protection to our hardy perennial plants, and hardly ever have any damaged. I am afraid there will be difficulties to overcome in the North West where I understand the ground freezes several feet deep. The tile might be protected in some way by covering with straw or some such material. This will be a matter for experiment and I shall be interested in the result."

The 1000-Kernel Weight of Seed in Relation to Experimental Error.(*)

BY M. O. MALTE.

Chief Botanist, National Herbarium,, Department of Mines, Ottawa.

A lecture delivered at the C. S.T. A. Convention, June, 1922.

Anyone with practical experience in variety tests with field crops is fully aware how difficult in many cases it is to avoid the disturbing effects of experimental errors on the results of variety tests. Larger or smaller numbers of factors may unexpectedly present themselves during the course of the experiments, more or less distorting them, and when this is the case, there is of course always a danger of erroneous or misleading results being recorded. How to avoid or minimize the effects of such experimental errors that may creep in when the experiments are in progress is, however, a rather complicated question which can not be dealt with in this connection. In the following, consideration will be given only to some errors which may be introduced in the experiments as a result of improper amounts of seed being sown. In other words, consideration will be given to the relation which may be found between experimental error and amount of seed sown in comparative variety tests. In discussing this question, an endeavour will be made to demonstrate that, in order to avoid experimental errors of a rather serious nature, it is imperative that the amounts of seed used in such tests be based on the relative weight of the seed of the various varieties, and not on the absolute weight, as is commonly the practice at present at most experimental stations in Canada.

The 1000-Kernel Weight.

The relative weight of the seed of different varieties ** of the various field crops is generally expressed in the so-called 1000-kernel weight, that is to say the weight of 1000 kernels, and is generally measured in gram. A few examples may be given in order to demonstrate that very large differences exist between the 1000-kernel weight of different varieties in cereals, grasses, and clovers. The figures, which herewith are presented in order to show the variation in the 1000-kernel weight, are either secured by the writer or taken from publications issued by the Plant Breeding Station of Svalof in Sweden. They are, it should be emphasized, selected solely for the purpose of demonstration and should by no means be regarded as in any way representing adequately our present knowledge of the latitude existing in the variation of the 1000-kernel weight.

In the case of *Rye*, for instance, the 1000-kernel weight in a comparative test conducted in 1910 at Svalof with 21 varied from 21.6 gram for the variety with the lowest 1000-kernel weight to 32.5 gram for the variety with the highest one. That is to say, 1000 kernels of the variety with the highest weighed just about 1½ times as much as 1000 kernels of the variety exhibiting the lowest grain-weight.

The same year, the 1000-kernel weight of ten varieties of *Barley* ranged from 41.43 gram for the lightest variety to 50.40 for the heaviest one. In this case 1000 kernels of one variety weighed approximately 1¼ times as much as 1000 kernels of another variety.

Great differences also exist in the 1000-kernel weight of other field crops. For instance, certain varieties of *Peas* may have a 1000-kernel weight 2½ times as high as that of other varieties, and the same applies to different varieties of *Horse beans*, whereas in *Vetches* the 1000-kernel weight of cer-

(*) Published by permission of the Director of Victoria Memorial Museaum, Department of Mines, Ottawa.

(**) Here, as in the following, the term "variety" is used in its narrower, botanical sense. The term is not used to designate crops such as wheat, oats, barley, timothy, etc., as is commonly done in agricultural reports and papers of a more popular nature, but to designate different breeds of wheat, oats, barley, timothy, etc.

tain varieties may be at least three times as high as the 1000-kernel weight of other varieties.

In the case of grasses and clovers there exist similar differences. Some 11 years ago the writer collected in the vicinity of Edmonton, Alta., with the assistance of Mr. Alfred Eastham, now with the Seed Branch of the Dominion Department of Agriculture, seed of about 450 individual plants of *Timothy*, growing under apparently the same conditions. At the time of collecting this material great differences were noticed in the various seed lots, some plants producing seeds which were about twice as large as those of others. However, no determination was made at the time of the range of variation in the 1000-kernel weight of these different seed lots of timothy, but it is rather safe to assume that the range of variation must have been considerable. In support of this contention it may be mentioned that in variety tests with timothy, conducted at the Plant Breeding Station of Svalof in Sweden, the 1000-kernel weight has been found to have a range of variation of from 0.21 to 0.88 gram. That is to say, that among varieties grown side by side and presumably under as identical conditions as possible there may be found certain ones in which the weight of 1000 kernels is more than four times as high as in others.

Of particular interest are some figures bearing on the 1000-kernel weight of different varieties of *Western Rye grass*. This grass, as the writer has had occasion to state on several occasions in reports as well as in special contributions, differs from the majority of grasses in being normally self-fertilized, like wheat. As a result, the existing forms of *Western Rye grass*, which can be collected by the hundreds in various sections of Canada and particularly in the West, breed normally true to type. In other words, large numbers of distinct and constant varieties can be easily secured simply by propagating the wild forms. Last year there were considerably over one hundred different Western Rye grass varieties grown at the Central Experimental Farm at Ottawa. When the seed of these varieties was harvested, it was noticed that the same weight-amount of seed in certain cases occupied very different amounts of space and, naturally, the conclusion was drawn that great differences might exist in the relative weight of the seed. Actual weighing of lots of 1000 kernels each of the various varieties subsequently brought out that the conclusion was a correct one. In the table herewith presented the different varieties are arranged in weight classes, each class having a range of 100 mg. It will be seen that while the average weight of the seed appears to be somewhere between 1600 and 1700mg. per 1000 kernels there are varieties that have a 1000-kernel weight as low as between 700 and 800 mg., and others which have the 1000-kernel weight as high as between 2600 and 2700 mg. That is to say, in some varieties the 1000-kernel weight may be over three times as high as in others.

Table 1.—Showing a number of different varieties of Western Rye Grass, falling into different weight-classes.

mg.	700 800	800 900	900 1000	1000 1100	1100 1200	1200 1300
No.	1	—	—	3	8	7

	1300 1400	1400 1500	1500 1600	1600 1700	1700 1800	1800 1900	1900 2000
No.	7	15	15	20	12	12	6.

	2000 2100	2100 2200	2200 2300	2300 2400	2400 2500	2500 2600	2600 2700
No.	4	1	2	1	—	—	1

In *Red Clover* there are, as is well known no perfectly uniform varieties developed so far, but an examination of the weight of the seed collected from individual plants growing under apparently identical conditions will easily prove that the 1000-kernel weight from various forms shows considerable differences. Thus, in 1911 the writer had occasion to examine the seed of a large number of individual plants and found that the range of variation in the 1000-kernel weight of different individual plants extended from 1.18 gram to 2.52 gram. Other investigators have found still higher 1000-kernel weight, the highest one, as far as it has been possible to ascertain, being 3.1 gram, i.e., almost 2½ times as high as the lowest one found by the writer.

The above examples are submitted in order to demonstrate that the range of variation in the 1000-kernel weight in varieties and forms within various species of field crops is considerable. Before proceeding to

analyse what significance this variation may have for the experimentalist who is striving to arrive at as correct results as possible in variety tests, a few remarks may be added relative to the inherent character and constancy, or rather relative constancy, of the 1000-kernel weight in the various varieties.

In the first place, the 1000-kernel weight may vary in the same variety from year to year, and secondly, it may vary under different soil conditions. As an illustration two tables are submitted, one showing the influence of soil conditions on the 1000-kernel weight in *Oats* and the other showing the variation of the 1000-kernel weight in the same varieties of *Wheat* from one season to another.

Table 2.—Variation of 1000-kernel weight of Oat varieties grown on different soils, Ultuna, Sweden, 1909.

No.	Clay	Rich Loam	Sandy Soil
1	26.25	30.30	33.05
2	25.70	29.55	30.25
3	25.95	26.85	29.30
4	23.50	27.60	29.00

Table 3.—Variation of 1000-kernel weight in *Wheat* varieties from one season to another, Ultuna, Sweden.

No.	1907	1908	1909
1	29.30	42.40	46.50
2	41.03	50.53	54.60
3	33.55	42.45	45.95
4	32.40	40.73	45.45
5	32.20	35.58	39.35
6	30.13	37.80	38.50

That such variations as those illustrated in the above tables should exist, is *a priori* to be expected, because the size and weight of the kernels are of course greatly dependent on the amount and nature of the plant food available in the soil, as well as on the climatic conditions under which the kernels are formed and ripen. In spite, however, of the variations which may be found in the same variety, the 1000-kernel weight of varieties of cereals is almost universally considered to be a character inherent to the varieties, in as much as the various varieties possess an inherent tendency to produce kernels of a certain shape and size and perhaps also specific weight.

Concerning the hereditary character of the 1000-kernel weight in grasses and clovers very little is known so far. There are observations on record which seem to indicate the existence of an hereditary relation between the 1000-kernel weights of seed in mother plants of *Red Clover* and their progeny, but our present knowledge on the subject is very fragmentary, indeed.

Whether the 1000-kernel weight is an hereditary character or not is, however, of minor importance in this connection. What is of importance is, in the first place, that different varieties may possess widely different 1000-kernel weight and, secondly, that in the same variety the 1000-kernel weight is subject to considerable fluctuations, caused by soil and climatic conditions.

(To be concluded in next issue)

Concerning the C. S. T. A. and its Branches.

APPLICATIONS FOR MEMBERSHIP

J. W. Graham, (McGill, 1922, B. S. A.) Live Stock Branch, Ottawa.

T. G. Hetherington, (McGill, 1917, B. S. A.) Experimental Farm, Fredericton, N. B.

Alex. McTaggart (Toronto, 1912, B. S. A., Cornell, 1913, 1922, M.S.A., Ph. D.) Macdonald College, P. Q.

R. D. Colquette (Toronto, '15 B.S.A.) O.A.C., Guelph

G. L. Jarvis, (Toronto, '21, B.S.A.) O. A. C., Guelph.

W. J. Strong (Toronto, '21, B.S.A.) Vineland Station, Ont.

J. Joyal (Montreal, '22, B.S.A.) St. Casimir, P. Q.

L. T. Chapman, (Toronto, '21, B.S.A.) Calgary, Alberta.

F. B. Hansen, Calgary, Alberta. (Associate.)

CORRECTION.

In the last issue it was stated that Dr. Alex. McTaggart, recently appointed to the staff of Macdonald College, had been formerly "agriculturist of the Department of Agriculture Museum at Wellington, N. Z." This should have been "Dominion Agriculturist in the N. Z. Department of Agriculture, with headquarters at Wellington."

COMMITTEE ON GRADUATE STUDIES

The following letter, mailed to the members of the above committee, indicates the extensive character of the investigations to be carried out during the coming winter.

University of Alberta,
Edmonton, Alta.
Sept. 1, 1922.

Dear Sir;

I had not the good fortune to be present at the Macdonald College meeting of the Canadian Society of Technical Agriculturists last June, but was subsequently advised that I had been given the honour and responsibility of the Chairmanship of the Committee on Graduate Study. The personnel of this committee was published in the July number of "Scientific Agriculture" as follows:—

M. A. Jull,
W. H. Brittain,
M. Champlin,
G. G. Moe,
R. D. Colquette,
G. Toupin,
B. T. Dickson,
R. Newton, Chairman.

In the same issue of the Journal there was published a report by Dr. F. C. Harrison, the retiring Chairman of this committee, and this report you have no doubt read, if you did not hear it at the convention. Dr. Harrison points out very fully the necessity for graduate training as a preparation for teaching and research work in agriculture, and indicates a beginning in the provision of facilities for this work in a few of our Canadian colleges.

In the published report of the 1920 organizing convention there is on page 84 a brief preliminary report by this committee.

While taking full advantage of any recommendations made by our predecessors in office, I think it would be profitable to have at the outset an independent expression of opinion by each member of the committee as now constituted, with regard to the policy we should adopt. Specific suggestions as to how the committee may function actively and usefully will be especially welcome.

In a general way I presume it may be said that our duty is to canvass thoroughly the whole situation with regard to graduate work in agriculture in this country, and to make reports and recommendations as we think wise. The present status of the work, facilities and opportunities for its expansion, the organization of graduate faculties and courses, prerequisites, length and content of courses, examinations and standards, language requirements, thesis requirements, credit for research at other institution, cooperation between colleges in particular branches, library facilities, special lecturers, exchange professorships, the encouragement of students by scolarships, fellowships and part-time assistantships—these are mentioned as some of the topics which should probably, sooner or later, receive consideration. However, I do not wish to suggest where we should begin until I have received an expression of opinion from the members of the committee. Possibly a division of labour will be suggested by which individual members of the committee will undertake the investigation of special phases of our work.

Since distance precludes the possibility of meeting often, we shall have to carry on our work largely by correspondene. I hope you will write me as soon as possible, stating fully your ideas with regard both to our general policy and to our best line of work for the immediate future.

Yours very truly,

(Signed) R. Newton,

Professor of Crop Physiology.

ERRATA.

In the last issue, article on "Application of Genetics", p. 17, col. 2, l. 9, "conditional" should read "conditioned".

Page 18, col. 2, l. 24, "prediction" should read "production".

Our Thanks to Technical Agriculturists in British Columbia

THE present issue is made up almost entirely of material received from British Columbia. The problems dealt with, in some instances, are peculiar to the western province and due to western conditions; in most cases, however, the contributed articles are of general interest, and will bring professional workers throughout the Dominion into closer contact with their associates in the Pacific province. That is worth while.

It is unfortunate that lack of space prevents the publication, in this issue, of all the articles received from British Columbia. An attempt has been made to include material covering practically every phase of agricultural work, and contributions that have been omitted will appear in later issues.

The idea of publishing special provincial numbers is one that might to advantage be carried further, if the present venture proves satisfactory to the general reader. A beginning has been made through initiative and effort on the part of members of the C.S.T.A. in British Columbia. Following their annual Convention, held in Vancouver in April last, at which a score or more of valuable papers were read, the opinion was expressed that the data contained in those papers should be given general publicity. The present issue was set aside for that purpose and the assistance given by the local branch in British Columbia has been invaluable. Their example is one which might well be emulated by other branches of the Society. Co-operation of this sort is needed.

Scientific research in agriculture, to be worth while, must benefit the farmer and improve farming methods. If the professional workers in Canada will keep in close touch with their colleagues in other parts of the Dominion and if outlines of their work, and results of their work, are brought to the attention of practical farmers, a tremendous good will be accomplished. In that national undertaking the Canadian Society of Technical Agriculturists, through its local branches and its official organ, can be of great assistance.

TECHNICAL AGRICULTURISTS IN BRITISH COLUMBIA.

Two groups at the Annual Convention of the C. S. T. A., in Vancouver, April, 1922.

Front Row: Dean F. M. Clement, E. A. Lloyd, K. McBain, President L. S. Klinck, W. A. Middleton, R. J. Skelton, V. S. Asmundson. Back row: R. G. Newton, W. H. Hill, W. M. Fleming, W. H. Fairley, H. E. Hallwright, E. L. Small, J. W. Gibson.

Front row, reading from left to right are: H. R. Hare, J. C. Readey, R. L. Davis, W. Newton, D. G. Laird, F. F. McKenzie, R. C. Treherne, E. W. Clarke, F. E. Buck, A. Morton. Back row: H. M. King, N. S. Golding, G. G. Moe, Miss M. J. Mounce, C. A. Lamb, E. E. Carncross, A. McMeans, J. W. Eastham, R. H. Helmer, J. C. Hay, Dr. J. Warnock.

Soil Microbiology—A Résumé and an Appeal.

BY P. A. BOVING.

Professor of Agronomy, University of British Columbia, Vancouver, B. C.

Soil bacteriology, or soil microbiology—which would be a better and more correct definition—comprises the study of those micro organisms which live and work in the soil, be it in cultivated land or in the untouched natural soil types which one finds on heaths, peat lands and in forests. The subject naturally divides itself into two branches. The one includes the purely biological study of organisms living in the soil. The other, the soil microbiology proper, deals with the micro organisms, and their activity, in relation to our cultivated higher plants. This branch, one might call it applied microbiology, naturally must build on the foundation of biological studies, must partly use the methods applied in that study, and cannot very well be set up as a science sufficent unto itself. To-day soil bacteriology, with both its branches, makes a demand, within soil science, to be placed on a par with chemistry and physics. Incidentally, it considers itself to be of even greater importance than mineralogy or geology, as far as soil fertility is concerned.

The elements, which are contained in the soil or incorporated with it in stable manure and plant residues, are transformed into available plant food largely through the activity of micro organisms. Soil investigation must shed light on those factors which affect the productivity of the soil. The importance and rank of soil bacteriology within soil investigation, therefore, become definitely established, because those applied or gradually incorporated and accumulated elements—particularly the nitrogen—are quite as important to soil productivity as are geological origin and the corresponding mineralogical composition. To this should be added that applied soil bacteriology seems to be able to hold out a helping hand to soil chemistry in that "microbiological reactions" have shown greater delicacy than chemical reactions and, in several instances, proven their superiority to chemical analysis as regards determinations of "available" plant food.

It should be remembered, at the same time, that soil bacteriology is a young science with a number of unsolved problems, a science which out of the state of action and reaction, in which every science ought to find itself, has only just precipitated a few practical results.

MICRO ORGANISMS AND FERTILITY.

Towards the end of the last century, and partly at the beginning of the present, it became more and more evident that micro organisms constitute an important factor in that conglomerate product which is called soil fertility.

A number of faithful workers tried to measure the size or the dimensions of this factor by determining the number of micro organisms to be found in the soil. Later investigations, particularly those conducted by the American *Conn*, have revealed that while the methods which at the time were recommended by *Hiltner* and *Störmer* (1) are not absolutely reliable, the number of bacteria, nevertheless, may give an indication of whether certain biochemical changes in the soil will or may occur with a stronger or weaker intensity. In this connection it might be of interest to note that *Conn*, *Waksman* (2) and *Brown* & *Smith* (3) have found the largest number of bacteria in different soils during the months of February and September and the lowest number during July and November, the absolutely highest figures being obtained during February and in frozen soil. The occurrence of bacteria in greater numbers during the winter than during the summer naturally

bears no direct relation to the volume of their activity, and it is this factor, of course, which should be determined.

Incidentally we have not yet been given a definite or complete classification of organisms living and working in the soil, but they have been the subject of considerable tentative grouping. From these determinations it would seem as if the fungi, of which the aforementioned *Waksman* has isolated at least 200 different species, may be considered of greater importance to soil fertility than hitherto assumed. Another group of soil organisms which so far have escaped more detailed study is represented by the actinomycetes which may constitute, according to *Waksman*, *Curtis* (4) and *Conn* (5) from 40 up to 50% of the organisms found on a plate.

In 1902, to be precise, the first attempts were made by *Remy* (6) to determine the activity of soil organisms by ascertaining "the volume of conversion" which would indicate relatively the microbiological condition of a soil. Since then Remy's methods have been modified and improved considerably, but further progress along this line will have to be made before the method can be said to be really effective.

SOIL INOCULATION.

Numerous experiments have been conducted from time to time with the object of increasing the productivity of the soil through direct inoculation with soil bacteria other than legume-B. In the majority of cases positive results have not been secured, largely because the "soil climate" has not been suitable for the development of the bacteria in question. Once the soil climate has been changed, through drainage, liming, application of manure, etc., the bacteria can begin to operate. Moreover, they will begin to do so, without further inoculation, in every case where stable manure has been used for the improvement of the soil climate. In other cases, i.e., where stable manure has not been employed, it would seem as if inoculation might bring about some improvement.

One remarkable exception should be noted: the experiments conducted by *Stoklasa* (7) with Azotobacter previous to 1910. Through inoculation he obtained the considerable increase of 2,000 lbs. of sugar per acre in sugar beets, as well as a decided effect in the subsequent barley crop, but—his results have not caused any revolution in the production of sugar beets, at least not yet.

CROP INOCULATION.

We are all so familiar with the economic importance of inoculation to leguminous crops that no reference will be made here to this subject, except to state that while much has been revealed to us, it is quite apparent that numerous problems still remain to be solved in this connection.

The benefits which have accrued from inoculation with bacteria for leguminous crops have caused considerable speculation and experimentation regarding the use of bacteria to other crops as well. A start was made with a German preparation "Alinit." The Germans have continued the manufacture of different preparations of this kind (8), and one recognized authority, *Prof. Hiltner* of Munich, is closely connected with the production of such cultures for mangels and sugar beets. Whether or not they will be effective remains to be seen. It would scarcely seem probable, however, that one would obtain a direct effect from the inoculation with non-symbiotic bacteria, but it is conceivable that their activity might exercise some stimulating influence on plant growth. *Prof. Bottomley* of England seems to favour this theory and claims that the bacteria produce so called "auximones" which play the same part in regard to plants as do vitamins to the animal organism. It is possible that there may be some truth in his contention, but so far his patented preparations have not brought about very great, or at least general, effects.

NITRIFICATION.

We are all more or less familiar with the processes connected with nitrification in the soil. Considerable work has been conducted along this line, and it has been shown lately by *Barthel* (9,10) and *Hesselmann* (11) that a comparatively intense nitrification may occur even in relatively acid soils. This fact is not in accord with earlier conception. Both Barthel and Hesselmann have found that organic nitrogen is nitrified more rapidly in such soils than is ammonium sulphate. Barthel has even shown that, in some cases, organic nitrogen may be nitrified more rapidly

in acid soils than in alkaline soils. Although their findings have been corroborated by *Fred* and *Graul* (12) it should be stated that these experiments were conducted with bare land, and that growing crops might have effected a different result.

Some years ago denitrification, or the disintegration of nitrate salts in the soil, caused considerable attention. Later investigations by *von Caron* (13) and others have definitely proven that unless the soil contains large quantities of nitrate nitrogen, as well as carbohydrates in the form of straw-pentosans, the danger of nitrogen loss through denitrification is comparatively small.

NITROGEN FIXATION

In connection with the activity of the free living nitrogen-fixing bacteria, it has been demonstrated that they need for their life processes some kind of energy material, either carbohydrates or organic acids. It does not seem as if Azotobacter and related nitrogen-fixing bacteria utilize cellulose as such, but that the cellulose must first be broken down. The most interesting deduction in this connection, at least to the writer, concerns the effect of different kinds of green manure crops. It has been claimed by a number of investigators, and contradicted by others, that "nitrogen consuming" green manure crops, such as rye and buckwheat, are as effective as the "nitrogen gathering" crops represented by our various legumes. The writer has made the same observations in a couple of cases, while in other cases including the majority of the writer's own experiments the legumes have surpassed non-legumes. A satisfactory explanation has been found by *Brown and Allison* (14) as well as by *Fulmer* (15) Brown & Allison are quite emphatic in their statements and suggest that extensive investigations be conducted regarding the relative effect of legumes and non-legumes as green manure. Their claim is that the order of manures from the point of view of nitrogen fixation through free living organisms, should be,—

1. Stable manure,
2. Non legumes,
3. Legumes.

They go even so far as to suggest that the turning under of non-legumes might be as effective for nitrogen accumulation as the plowing down of legumes, because Azotobacter and other non-symbiotic nitrogen gatherers prefer non-legumes as a source of energy.

SOIL TIREDNESS.

A topic which has caused considerable discussion and interest is the question of the tiredness of the soil. We all remember the theory of "toxicosis" as launched by the Americans some 10-15 years ago, when *Whitney* among others claimed that our cultivated plants give off certain toxic substances which would be harmful to plants of their own kind. In 1909 *Russell and Hutchison* (16) propounded the theory that protozoa in the soil, through diminishing the number of bacteria, might inhibit microbiological processes to such an extent that it would affect the life processes of our cultivated plants. They suggested that an abundance of protozoa might be the cause of the "weariness." American investigators have gone into this question very thoroughly and neither *Koch* (17) nor *Waksman* (18, 19) consider that the protozoa exercise quite the influence as claimed by Russell. It is correct to state, I believe prevalence of protozoa reduces the number of bacteria, but the intensity of conversion (as measured by the ammonification process) is not lowered. *Goodey* (20) has obtained the same results, and *Kopeloff* and *Coleman* (21) who have made a complete survey of protozoa investigations, come to the conclusion that the Russell theory is untenable.

BACTERIA AS INDICATORS.

In the introduction to this paper it was mentioned that soil micro-biology in certain respects has reached out a helping hand, so to speak, to soil chemistry. Particular reference was also made to the excellent work conducted by the Dane, *Harald R. Christensen* (22), who through his Azotobacter test has given us means by which the line requirements of a certain soil can be determined with an exactness which as yet has not been presented by anything but very intricate chemical analysis. It seems as if a similar method might be evolved in regard to the determination of available phosphoric acid, and we shall have advanced a tremendous step in crop production and in the handling of soils, once these two factors, active lime and phosphorus, can be deter-

mined through a relatively simple and yet accurate laboratory test.

SULFOFICATION.

Soil microbiology, particularly during the war, has also attempted to enter the field of the chemical industry in that attempts have been made, even on a large scale, to utilize the activity of the sulphuric acid-forming bacteria in the manufacture of soluble phosphates. *Lipman* and others (23, 24, 25) have done considerable work along this line, and the right proportions for fairly successful sulfofication have been worked out. It has been found that,—

100 parts of soil,
120 parts of sulphur,
400 parts of raw phosphate,

give the best results, and that the process is hastened by inoculation with sulphuric acid forming bacteria. However, it is very questionable if, so far, this method will have any considerable future in connection with the manufacture of commercial phosphates as, in spite of inoculation, the process requires considerable time. It is quite probable, on the other hand, that it may be successfully employed in home preparation of bones, as well as of raw phosphates in certain localities.

These bacteria, the sulphuric acid forming, have been utilized with considerable success in combatting the potato scab (26). 300-1000 pounds of sulphur per acre applied to the potatoes seem to eliminate or prohibit the activity of the scab fungus.

CONCLUSION.

From this brief and incomplete résumé, it is quite apparent that the micro organisms, and their activity, play a very important part in the nutrition and growth of our cultivated plants. That there are yet many problems to be solved is evidenced not least by the fact that so many eminent workers are employed in the study of the microcosmos of the soil.

The reason why the writer has attempted to deal with a subject with which he is relatively unfamiliar is this, that he feels thoroughly convinced of its importance and wishes to urge upon the members of the C. S. T. A., as well as upon the authorities of our Agricultural Colleges, and upon those connected with agricultural experimental work generally, the necessity for paying greater attention to soil microbiology. Every one of us is looking towards, dreaming about, and attempting to discover the land of promise. When, to our joy and infinite wonder, we have obtained a glimpse of the marvels of that land of promise, it is our duty, and becomes our pleasure, to tell the world about it.

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Problems of Inheritance in Poultry.

BY V. S. ASMUNDSON

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Inheritance and variation have played an important part in the improvement of poultry. Crossing followed by selection has been the standard method used to produce new breeds. Selection since the original crosses or introductions were made has proved a powerful though somewhat slow means of perfecting the breeds for fancy points. With the development of commercial poultry production, the same methods used in originating some of the breeds, have been applied to the creation and improvement of heavy laying strains. The success of these methods is amply attested to by the records obtained at Laying Contests and elsewhere.

Extensive studies have been made on variation and heredity in poultry. The comparatively rapid rate of reproduction and moderate cost of handling, account for the wide use of poultry for such research. Most genetic problems of economic importance are so complex, however, that several generations comprising large numbers of individuals are required for their solution. Usually they also involve considerable detail that adds to the expense and the time that has to be devoted to them. This probably accounts for the small number of investigations of economically important characters that have been carried to a conclusion with poultry.

Much of the breeding work done by the Poultry Departments of Agricultural Colleges and Experiment Stations on this continent is based on selection. This is often supplemented by progeny testing, a distinct step beyond the breeding operations of the average poultryman. Where progeny testing is combined with careful selection, the stock beomes practically homozygous for the characters selected and hence more valuable for improving the productive qualities of ordinary flocks. There are several instances where experiment stations, through years of selection, have produced practically pure strains of high laying birds. It should be recognized that the value of such stock is practically inestimable.

Where other than selection work has been done, the interpretations given in many cases are still in dispute and lack confirmation. For this reason it is impossible to predict results of mating between individuals of known ancestry. The only advice on breeding that can be given to the poultryman is to select for the desired characteristics. This condition should be remedied. The fact that it exists is a proof of the need for investigation of fundamentals so that definite information can be given to the breeder.

The problems that require investigation are chiefly problems of economic importance such as fecundity, size and color of eggs, and such characteristics as precocity and broodiness that have a direct bearing on fecundity. There are other characteristics that are assuming an increasing importance since the introduction of Dominion Record of Performance. These are the standard disqualifications, particularly "stubs" or leg feathering and flecking in the plumage of white birds. There are other problems of a purely scientific interest at present that may in the future be of considerable economic importance. These are exemplified by certain breed characteristics especially those that are sexlinked.

The most important problem that the breeder must face is fecundity. Much data has accumulated to show that fecundity is inherited and two theories have been postulated to explain the mode of inheritance. The first of these was advanced by Pearl who laid greatest stress on winter production on the assumption that it was something added to a natural laying cycle common to all birds. The inheritance of winter production would then also express the genotypic differences between birds of high and low fecundity. Pearl further claimed that the male is more important than the female in pro-

ducing highly fecund daughters because one of the two factors necessary for maximum winter production is sexlinked and therefore never transmitted from dam to daughter. The validity of this theory has been widely disputed, particularly the presence of sex-linkage.

Another and more recent addition to the study of this subject is that made by Major Hurst. According to his interpretation fecundity as expressed by total annual egg production is divided into three periods, winter spring and autumn, and the intensity of production for each period separately inherited. Further precocity is inherited and is of great importance in determining winter production. Broodiness and size and color of egg are also included in the study, all seven characters in their hereditary behaviour showing a 3: 1 ratio or a single factor difference.

Hurst like some recent writers emphasizes the complexity of fecundity. The assumption that fecundity is not a homogeneous whole, but rather a comlex of many more or less integral parts, seems entirely justified. Because of the complexity of the problem, there has been a tendency to accept the first available explanation without first thoroughly testing out alternatives. This is probably one valid objection to Hurst's interpretation of his data. However, the report is not given in sufficient detail to permit judgment on this point.

It would be a great boon to breeders if it were possible to judge a hen's breeding ability from an examination of her egg record. Hurst suggests that an annual record of 300 eggs indicates that a hen is homozygous for all the factors whose presence determines high egg production. It would seem then that breeding from hens with annual records of 300 eggs would be a critical test of this theory.

When we consider the results of breeding from hens with records below 300 eggs in 365 days, the problem is more complex. This is brought out by the accompanying table which shows that a hen with an annual record of 258 eggs was an inferior breeder to a hen with a record of 212 eggs in 365 days. Neither is a poor producer or shows low fecundity, but the difference is great enough to show the fallacy of pen mating based on a difference in annual production of 20-30 eggs. This comparison also seems to indicate that in White Leghorns the genotypic constitution of the dam is an important factor in determining the fecundity of her daughters.

A phase of the study of fecundity is the use of statistical methods for the study of normal production for the whole year and for different parts of the year, the numerical relations existing and the variations to be expected under normal conditions. Genetic constitution of the flocks as well as weather and other environmental conditions would play an important part in determining production at various times of the year. Any conclusions would therefore have to be based on figures obtained under conditions similar to those for which they were to be used. Data obtained from such studies would be of value for prediction purposes and hence could be used to check the actual

S. C. WHITE LEGHORN MATINGS.

Sire No. 225. Sire's Dam No.150—1st year record 198 eggs.

Dam No.	Dam's 1st. year production	No. of Daughters With record of over 200 eggs.	Total	Aver. Annual production of daughters	Range of daughters' Annual prod.
20	212	5	5	231	200—264
23	258	4	6	189	120—228
26	226	8	10	213.7	153—267
	Sire No. 527. Sire's Dam No. 153—1st year record 241 eggs.				
56	169	5	5	220.5	204—235
57	233	2	2*	175	161—189.

* 2 Pullets died before finishing the 365 day period.

with the expected production in the official certification of records such as the Dominion Record of Performance. It should help to make this work more efficient, a work that is proving of tremendous importance in directing attention to the value of breeding for increased production.

Hatchability is a factor of great importance in determining the success or failure of breeding. Pearl found some evidence to show that hatchability is inherited but little or none to show that the same is true of fertility. It is certainly true that the progeny of some matings give persistently higher hatchability than those of others. Environment however, plays such an important part that an investigation of the effects of various feeding and other practices seems to offer the greatest possibilities for immediate advance. A study of the genetic principles involved should then come later.

Broodiness is a characteristic or instinct of the hen that has considerable effect upon her production. Non-broodiness is considered desirable if for no other reason than that broodiness adds to the labor of caring for a flock. Hurst assumes a one factor difference between broody and non-broody hens. He notes a number of exceptions however, that indicate that this is not an entirely satisfactory explanation.

Goodale believes that in Rhode Island Reds, broodiness depends on two interacting factors with some evidence to show the presence of an inhibiting factor. If this is true, then two non-broody strains when crossed would be just as likely to produce broody as non-broody hens, a result that would be entirely unexpected by the breeder.

SIZE OF EGG.

The inheritance of size of egg has been briefly referred to in connection with Hurst's paper on the Genetics of Egg Production in White Leghorns and White Wyandottes. According to this authority there is a one factor difference determining the size of eggs, the factor for small egg size being dominant to the factor for large egg size.

From analogy with other cases of size inheritance we would expect that the hereditary basis of size of eggs was more complex than indicated by Hurst. It illustrates the problem so commonly encountered in genetic research where it would seem desirable to first carry on selection to establish pure lines or at least to determine as far as possible the normal variability. The inheritance of size of egg is the kind of problem that requires years of effort to secure definitely dependable results.

Size is a factor of increasing importance to poultrymen because of the demand for a standard product. Eggs for export and even for inter-provincial trade must be graded for size. Moreover no bird can qualify for a certificate under the Dominion Record of Performance whose eggs do not average 24 ounces to the dozen. This makes it very important to maintain size, which is sometimes a difficult matter when the temptation is to sacrifice size for numbers.

Color of eggs is a problem that, while not of such immediate importance as size of egg, will command more attention as the finer grading of eggs comes into greater demand. The chief importance of this problem from the economic standpoint is the occurrence of tinted eggs from Leghorns and other breeds that lay a 'white' egg. There are probably few flocks where selection is unnecessary to maintain whiteness of egg.

A simple 3: 1 ratio of brown to white eggs was obtained by Hurst with further indications that modifying factors determined depth of pigmentation. He does not make it clear whether these results apply to Leghorns or not, as his conclusions are presumably based on crosses between White Leghorns and White Wyandottes. If they do apply, then it should be possible to produce a strain laying only white eggs, by the elimination of the tinted eggs when selecting for incubation.

From observation it can be stated that White Leghorn pullets consistently lay an egg of similar tint to that of the dam. It has been proved that selection is effective, but to solve the problem of the inheritance of this character, it would probably be necessary to establish two homozygous strains and then cross. An important consideration is the selection of color grades that are standard and thus available to other investigators.

There are a number of other problems requiring the attention of the geneticist that might be enumerated, but enough have been

mentioned to show their range and complexity. There are many of these confronting the breeder every day. For instance, the White Leghorn breeders used by the Poultry Department on the plant at Point Grey are selected for size and type, freedom from standard defects, winter and annual, or 365 day production as well as persistency, precocity to a certain extent, absence of broodiness, hatchability, size and color of egg and lastly on the basis of the performance of their progeny.

The list of characters that the breeder must select for is long and shows the need for research. Every experiment station should choose a problem for the purpose of solving it so far as our present knowledge of the laws of genetics will permit. A part of the stock and equipment could be set aside for this while the rest is used for the usual lines of work. With proper co-operation there need be no over-lapping of effort though a certain amount of duplication is desirable for the purpose of checking results.

Instead of working on a project such as "Which is the more important in the transmission of egg color, the male or the female?", the problem should be "What is the mode of inheritance of egg color?". The latter includes a solution of the former, which does not neessarily include the latter, and is therefore in every way more worth while. It is time we got down to a study of fundamentals. The trouble is that investigations of a more or less popular nature can be carried on when the labor involved prohibits strictly scientific research. There is another factor, the demand for experimental work, a demand that very often does not discriminate between experiments that are of passing interest and those that have a permanent value. It would seem that the time has come for devoting at least some of the available facilities to actual research so that while satisfying the demand for immediate information some provision may be made for the demand of the future which will be more exacting as knowledge of breeding becomes more widespread.

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Improvement of Farm Crops in British Columbia.

BY G. G. MOE

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In this paper it is not my purpose to refer specifically to the breeding of each individual crop, but rather to outline in general terms some of the problems and methods connected with the improvement and amelioration of farm crops in this Province.

In order to present clearly the various phases of crop improvement and indicate the methods whereby we hope and confidently expect to continue our production of improved strains and varieties adapted to the many varied climatic areas, it is expedient to refer to the changes and progress in breeding methods that our modern knowledge of genetics has made possible and advisable.

It is significant and indicative of the value of the work of the early breeders that plant breeders of to-day are employing most of the methods that the pioneers in crop improvement discovered and developed. Thus we still employ Rimpau's system of mass selection, the individual plant selection methods of Hallett, Nilsson and Hay, while one's eye is always alert for the rare mutation which is known to exist, but is so seldom found. Johannsen's work with pure lines has demonstrated the futility of further selection within pure lines of self fertilized plants. In short, no early method or theory shown to be based on fact has been dropped from the plant breeder's kit. Such

method or theory may have been modified in the light of further research, but sooner or later its proper use has been realized and it has been retained as one of the essential tools of the geneticist. The development of Mendelism will undoubtedly rank as one of the great scientific accomplishments in research of the present century.

As old varieties are purified, so that it becomes impossible to make further high yielding selections from them, and as the different countries of the globe are searched more and more for new types, which may be of value under similar climatic conditions in some other parts of the world, the plant breeder will face a paucity of material from which to select, test, and introduce new varieties and strains. It is at this point that hybridizing, and its possibilities as revealed by Mendel and later workers, opens before us a clear way whereby new varieties may be produced that (a) are superior in yield to one or both of the parents, (b) better than either in their adaptation for the particular conditions the breeder had in mind at the time the cross was made. The original work of Mendel demonstrated the laws of segregation for characters which were defined as simple or unit characters, and it was assumed that all morphological characters on crossing would behave after that manner. Recent researches of biologists and plant breeders show that there are but few characters which may be regarded as simple or unit in their Mendelian behaviour. As the genetic constitution of each is examined, it is found that they are generally complex, that each may carry one or more factors, and that the ratios obtained from any cross will vary according to the characters involved and the nature of the cross.

While a full knowledge regarding the intricacy of these Mendelian phenomena is not absolutely essential to the plant breeder, as witness the productions of the early hybridists such as Farrar, Saunders and others, it is nevertheless true that its possession affords the plant breeder a greater possibility for interpretation of the probable behaviour of the hybrid generations, it assists him in shortening the period of heterozygosity and reveals to him when he has reached an impasse.

It is not my intention to refer further to the genetics aspects of plant breeding, except as it may be necessary when considering the improvement of our different farm crops. For purposes of discussion these crops may be grouped as follows:—

Wheat, oats and barley.
Grasses,
Clovers,
Corn and Rye,
Potatoes,
Roots.

Small Grains.

Considering the first group of field crops which includes wheat, oats and barley, the objective in any breeding work in this Province must be the selection of high yielding strains adapted to the different climatic areas. In this our objective is the same as that of our co-workers in other Provinces of the Dominion, with this addition, that in our fair Province the field is larger, owing to a considerably greater climatic variation. Wheat, oats and barley being presumably self-fertilized, breeding methods are somewhat simpler than those employed for other crops. Nevertheless, careful investigations by a number of workers in recent years have shown that the percentage of natural crossing between small grain varieties is considerably greater than generally assumed and that due precautions must accordingly be taken. On the University site at Point Grey we are now applying a system which aims, not at a direct control of natural cross fertilization, which is economically impossible, but at the insuring of a pure supply of seed at all times of our leading varieties and strains. This system is based on the plan of yearly selection of pure lines from pure lines (a pure line being the progeny of a single self-fertilized plant), and means an elimination each season of those lines which give an indication of natural crossing having taken place in previous seasons. Time and space will not permit of a detailed explanation, but it may be sufficient to say that the system disposes to a great extent with the roguing of plots and the cumbersome hand selection of seed in the laboratory. A short article on this method will appear in an early number of "Scientific Agriculture."

Grasses and Clover.

The problems connected with the breeding of grasses and clovers are much more complex than those surrounding the breeding

of grains. Before dealing with the methods employed one may be excused for referring to the importance of this particular work. To start with there are practically no distinct varieties or strains of grasses and clovers in commerce. Such varieties as are given distinct names are not the product of a definite breeding operation, but are the result of natural selection. Through this agency, they have become adapted more or less to some particular region or country and have very often been given a regional name. It has to be admitted that certain strains of grasses have been produced at Svalof in Sweden, at Cornell in New York State, and in West Virginia, but so far none of these have found their way into the trade of the American continent. In this Province there is a particular need for improved strains of grasses and clovers, superior in adaptability to the commercial material.

In grains a variety that is high yielding in other parts of the Dominion is very likely to prove a high yielding and desirable variety in this Province. Whether this holds true in regard to grasses and clovers has not been proven. Anyway early, medium and late strains are wanted. Strains that are high yielding, with fine hay quality and adapted to different soil and moisture conditions are particularly desired. Strains suitable for pasture purposes and strains that are hardy are badly needed. In fact, it would be impossible in this connection to do anything but barely indicate the field for this line of work. Reference has just been made to the fact that commercially we have no distinct varieties and strains, as these are generally understood. The difficulties attending their improvement have in the past proved too great an obstacle to be entirely overcome. In this connection, we will refer to the grasses, separately from the clovers, as the latter present even more difficulties than the former.

The fact that grasses are wind pollinated and to a certain extent self-fertile makes three methods of improvement possible,—

1. Ordinary mass selection.
2. In-breeding followed by crossing with a similarly imbred type.
3. Vegetative propagation of selected types followed by the crossing of two similar but unrelated strains.

The last method is the one we are largely employing at Point Grey, although method No. 2 will also be employed as soon as space and facilities permit.

Clover being insect-pollinated and strictly self-sterile, the application of method two, as in grasses, to their improvement is impossible. Method three, that is the vegetative propagation of selected desirable types, followed by the crossing of two similar, but unrelated strains, is the one we are following at present. We do not in any way claim originality for the idea of progagating clovers vegetatively, but we do claim originality at least for Canada, for the idea of including vegetative propagation in clover breeding plans. This method is now on trial, and while its full practical value has not as yet been completely ascertained, we feel confident that in it we have a very efficient aid in the production of new varieties of clover. Briefly, our plan is this: to gather seed from outstanding individuals growing under natural conditions and then plant a number of seeds from such individuals so as to observe the homozygosity of the type. Among uniform progeny possessing the desired characters, one plant is selected, is propagated vegetatively, and the "cuttings" put out in comparative rows for a yield test. On the basis of yield and similarity in morphological characters, two strains are selected for mating. All plants from each of these two strains have been propagated vegetatively when the entire lot is put out alternately in a composite block as far as possible removed from surrounding clover fields. The flowering of the plants in this block is controlled until after the blooming of the ordinary clovers, following which seed is taken for the first time from these plants. It will soon be possible to judge of the efficiency of this method as the work with a number of selected strains is now in its final stage.

Alfalfa breeding differs only from clover breeding in that, although the alfalfa is normally insect pollinated, it is nevertheless self-fertile to a considerable extent. On this account it is possible by tripping the flowers to practice inbreeding coupled with hybridizing. This plant also lends itself well to vegetative propagation.

Corn and Rye.

Improvement work with corn is not possible in our coast climate. Such work as may be done in this province with this crop will

have to be performed under the favourable climatic conditions of the southern Okanagan. Inbreeding followed by outcrossing is the accepted method of improvement. The economic advantages of F_1 seed should not be forgotten.

Rye has been included in the same category with corn, as being wind pollinated and also to a certain extent self-fertile, it lends itself to improvement either through mass selection or inbreeding. Spring rye has shown itself to be so poorly adapted to Coast conditions as compared with fall rye that improvement work has been confined entirely to the latter crop.

Potatoes.

Potatoes are one of the most important field crops of the Province. On that account they receive a proportionate share of attention. One may add also that there are few crops so worthy of improvement, and in which so much improvement is needed as the potato crop. Considering the large number of varieties that are being grown in the Province, it is obviously imperative that these be thoroughly studied before breeding work is started, it being a sound scientific principle oft quoted: "From the known proceed to the unknown." This principle is being followed in all breeding work.

As a number of the commonly grown and popular varieties of potatoes present a mixture of types, three methods of potato improvement may be followed,—

1. The purification of varieties and the isolation of pure lines.
2. Utilization of possibly occurring bud mutations.
3. Development of new varieties from seed.

We have as a result of the first method the "U.B.C. Spud", a selection out of "British Queen." This variety or strain has outyielded all other varieties over a four year period. Other promising strains are now under process of testing, The "U.B.C. Spud" may have been an accidental admixture in "British Queen" or it may have been a bud mutation. It is impossible to tell.

From seed balls it is possible to bring into being new varieties. This system is slow as it often requires three years of propagation for the tubers of a new strain to attain normal size. Following that they must be subjected to comparative tests. This phase of potato improvement is an integral part of our potato breeding programme.

In connection with potato improvement work, hill selection should be mentioned It is only in old mixed varieties that hill selection causes directly increased yields or results in the permanent isolation of high yielding strains. Indirectly hill selection maintains the yield of new strains, in that diseased hills of weakened vitality are eliminated. As a direct means of increasing permanently or lifting gradually to a higher level the yield of a new strain, it is as ineffective as continued selection within a pure line of self-fertilized cereals, barring of course the possible though problematic appearance of a bud mutation, which it may bring to light.

Root-Breeding.

Apart from turnips, the other classes of roots as far as yield is concerned, are unaffected by climatic conditions. In other words high yielding families of the different root crops hold the same relative position irrespective of whether they are grown under the cool conditions of Scandinavia, the hot conditions of eastern Canada, or the intermediate conditions of the Coast. On our experimental grounds the aphis has interfered so seriously with the growing of turnips and swedes that improvement work has been impossible with these crops. The main principle followed in our breeding work with roots is that of inbreeding and recrossing of similar types.

Having considered the various divisions of farm crops separately, I wish to draw your attention to a different grouping of the problems. Plant breeding or genetical research naturally divides itself into three phases,—

1. Problems which are purely practical—as an example of which we may quote the vegetative propagation work with clovers.
2. Problems which are semi practical and semi scientific—such as the study of any new combinations of characters and their segregations in the hybrid generations, while seeking the fixed strain with the desired characteristics.

3. Problems which are purely scientific—as an example of which may be quoted Mr. Derick's pending investigation on the genetic constitution of a natural cross in hulless oats.

At an educational institution such as this, the three phases must be maintained in order that illustrative material of the different phases of genetics, as applied to plant breeding, may be available for classroom work.

In conclusion allow me to state in general terms what would appear to me to be the broad lines on which plant improvement work with field crops should be pursued in this Province.

(a) The purification of existing varieties and strains and the maintenance of pure lines of stock seed.

(b) The introduction and testing of varieties produced in other provinces or countries.

(c) The production of new varieties and strains by hybridizing and selection.

(d) The testing out of strains of varieties produced or discovered by different farmers in the Province.

With all due respect for and sincere appreciation of the results obtained by co-workers in other parts of the Dominion and the world at large, it may be ascertained, without fear of serious contradiction, that there is still a wide and open field for interesting and important work in our Province along the lines of plant breeding and plant improvement.

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Plant Breeding Problems as Related to Horticulture.

BY F. E. BUCK

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Genetics has been defined as "the science which deals with the coming into being of organisms by breeding carried on from generation to generation". It is breeding under rigid control so that we may know what is happening. And it has been suggested that "we may confidently look forward to a time when a method of continuous control may be employed in all breeding experiments". (Lochhead, "An Introduction to Heredity and Genetics".)

At the present time every plant breeding or genetic problem ,conducted either in the interests of research or in connection with some particular investigation is planned to supply an answer to some particular question. The answer it finally supplies may be agreeable to the investigator or it may be one which upsets all his calculations. It may be fairly complete, or extremely incomplete. It may be positive or negative, but provided the technique of the experiment does not break down, and the experiment itself deals with some definite problem, some answer is practically assured. One reason why our answers are so varied is that very little of this "continuous control" is possible, even under conditions which from some standpoints, are approximately ideal. Our handicaps are several, and one of the chief is the fact that we have no acceptable "theory of heredity and inheritance" upon which to base our plan of research. Bateson states that "an exact determination of the laws of heredity will probably work more change in man's outlook on the world and in his power over nature than any other advance in natural knowledge that can be clearly foreseen" ("Problems of Genetics".)

It is of considerable importance that, in spite of handicaps, in planning our experiments in every department of science we clearly perceive the possibilities of any

single experiment, both in relation to its research as well as to its economic value. We should be able to ascribe relative values to experiments before they are started. This might be made easier by a more critical study of past accomplishment, such a study to be made with a view to becoming a guide to directions in which we should proceed in connection with projected work.

In British Columbia at the present time there are some dozen or more problems of genetics as related to the science of Horticulture, which from the commercial standpoint might be profitably investigated. These problems have to do with Fruits, Vegetables, Ornamental Plants and Lawn-grasses. Of this number some of them, it is believed, have a higher potential research value than others, and in this paper the question is raised as to whether it is possible to plan and conduct some of them so that they may in no uncertain manner contribute to the findings of pure research. The consideration of this phase of the subject in relation to Horticulture will undoubtedly take us afield from the restricted science of Horticulture, and it is well therefore to deal first of all with the problems from their economic aspects.

To give a list of these problems and offer a few brief remarks with respect to each is all that may be necessary, particularly in view of the purpose in mind to discuss the research phase of the question in greater detail.

FRUITS.

Strawberries.

The variety Magoon is one of the very best for British Columbia conditions. It has, however, certain faults and is not ideal for either shipping or canning. Improvement should be possible by both selection and hybridization. In the case of the variety Paxton an interesting and profitable objective would be to obtain a Mutant or a seedling having the qualities of the parent, but which produces perfect flowers. Paxton at the present time has imperfect flowers, and therefore cannot be planted alone. In emphasizing the desirability of originating new varieties for provincial conditions on account of their suitability for local conditions, it is interesting to note that the four leading varieties in the State of Oregon, viz: Clark, Magoon, Oregon and Gold Dollar were all originated in that State.

Raspberries.

Red raspberries constitute the second most important small fruit crop of the province, and nowhere else in Canada can the canes be grown to such a degree of height and stoutness. Seldom, however, can a full crop be harvested from a new plantation until the third year. It seems desirable therefore to attempt to work for a type of plant through breeding or selection which produces stout canes with lateral branches. There are also the questions connected with the practice of tipping back the canes and the methods of training. The objective in this work would be to gain a year in the matter of harvesting a full crop, which would have an important economic result, particularly with persons commencing the work of small fruit growing on a commercial scale.

Pears.

The pear is a fruit which is very seldom seen on the market after the middle of December. The object in the breeding and investigational work with the pear would be two-fold, first to produce varieties with better keeping qualities—in order to obtain the good prices that might be obtained for them after the middle of December—and second to breed for varieties which would prove to be resistant to the disastrous blight diseases which now attack many varieties of the pear.

VEGETABLES.

Tomatoes.

The tomato as a commercial crop ranks very high. As a crop grown for the canneries it can well be made the subject for improvement. Better canning varieties can be produced by means of breeding or through improved methods of handling the crop. What is needed for the canneries is a fruit which is firmer and better proportioned in its internal structure with respect to water and pulp content. Earliness of ripening would also be an issue of the problem. Canneries are eager to obtain a better grade of fruit, which if produced would have an influence on the quantity sold to the public.

Peas.

In the case of the pea also certain parts of the province are well adapted, particularly with respect to climatic conditions, for growing field peas for canning purposes. The factors of uniformity of size of the pea so that the pod is evenly filled, and of flowering habit so that all the pods mature at about the same time, are of great importance. It is possible to breed or select for these qualities, which if produced would make certain varieties stand out as most suitable for growing for the canneries, and might result in a very much greater acreage grown for canning purposes.

Kale, Broccoli, Globe Artichoke.

All three of these vegetables offer a very fascinating field for investigation. Kale at the present time is the main winter green feed for poultry in both British Columbia and the Pacific Coast states. This year, owing to the severity of the winter, almost the entire crop was lost, which meant a considerable financial loss to the poultrymen. It is already fairly well established that the resistance to cold of these three vegetables can be considerably increased in two ways as follows: (a) By cultural methods. The author of "Some Rarer Vegetables" states that he has frequently noticed that the Globe Artichoke will survive the winters in the north of England and Scotland, while winter-killing in the south of England where the winters are very much milder. This phenomenon he ascribes to the fact that in the north the plants are grown on well-drained soils; while in the south they are grown on the richer low-lying soils, and as a result have a very much higher water content than those grown on the lighter soils of the north. (b) The second method of increasing resistance to cold is by increasing the pentosan content of the cell. The results obtained by J. T. Rosa, and reported in the "Proceedings of the American Society of Horticultural Science", 1920, page 207, who worked with cabbage, cauliflower, lettuce and tomato, are of interest in this connection. The problem of increasing this pentosan content of the cell is intimately related to cultural methods. By modifying cultural methods and by breeding and selection, it should be possible to produce a strain of Kale, which, except under extraordinary conditions, could be depended upon to withstand British Columbia winters. In the case of the Globe Artichoke this vegetable is at present largely imported into the province, but might just as well be grown more largely here, and were it better known it would be in greater demand.

Three quarters of an acre of onion seed
Yield: 860 lbs per acre.

ORNAMENTAL PLANTS AND LAWN GRASSES.

Flowers.

In the case of flowers and other ornamental plants there are at the present time a number of problems needing investigation. From the commercial aspect there is a great future for this type of crop in the province. Many classes of plants which can be grown here successfully are now imported in large quantities Successful and commercially profitable beginnings have been made with a few specific crops. Sweet Peas furnish one example. Roses budded on to British Columbia native stocks furnish another example. Over 100,000 plants produced in this way have been sold during the past six years, but this constitutes only one-third of the total number used in the province, the other two-thirds being imported. They are imported for no other reason than that the industry is still an infant, and cannot do better for its foster parent. This industry holds out great attractions for the commercial man with experience and a little capital, and has even greater potentialities from the standpoint of the investigator and plant-breeder.

Dutch bulbs such as tulips and narcissi, have been worked on to some extent at the

Sidney Experimental Station, and every hope can be held out that bulb-raising will some day take rank in the province as an important floricultural industry. The United States Farm where investigational work with these bulbs is carried on, is situated within fifty miles of Vancouver. At the University Farm at Point Grey several interesting problems for investigation have already presented themselves in connection with the small collection of Dutch bulbs which the Horticultural Department has out there.

There are several other flowers and classes of ornamental plants, which if space permitted should receive mention.

Lawn Grasses.

This brief list of investigational problems, several of which are bound to become important from a commercial standpoint at no distant date, would be incomplete without mention of the problem of lawns and lawn grasses. The climatic conditions of parts of the province are such that soils laid down to grass rapidly tend to become sour, with the result that the lawn grasses are killed out and moss infests the lawn area. This is a problem partly for the soil expert, but it also belongs to the Horticulturist in that it may be possible to breed and select lawn grasses which will succeed better on slightly acid soils. Certain plants have affinities for types of soil which tend either to acidity or alkalinity, and in the case of British Columbia lawns it is a matter for investigation and experiment as to whether we shall be able to select "the plant which will be more suitable to the soil" as well as make "the soil more suitable for the plant".

NOTE: In each of these examples it will be noticed that the economic aspect of the problem has been emphasized. Note should be taken of the fact that each problem could be attacked with the greater likelihood or a successful result in proportion to the amount of study that was given to it from a genetic or pure research standpoint. In some cases collaboration with the soil expert would be desirable, in others with the bio-chemist and physicist.

The Strictly "Research" Phase.

Horticulture as a distinct science has made several important contributions to the study of genetic problems, not the least of these being Mendel's Laws, and it is quite conceiveable that horticultural plants in particular offer an excellent medium for the study of these problems, particularly such phases

Raising "Flower-seeds" is a new industry in British Columbia. This shows one of the seed farms. Sweet Peas as grown for the British firms are shown in the right of the photograph

as Heredity, Mutations, Adaptations, Cytoplasmic Inheritance, Variation and others; but it is not desirable that these or any fundamental phase of genetics should be considered as in any sense related solely to horticultural plants.

The artificial divisions of experimental science which tend to separate one worker from another and throw him upon his own initiative in research matters is a real and distinct handicap, which might be overcome in part by some system of check questions, the outcome of a definite study of past accomplishments already referred to in the opening paragraph of this paper, such questions to be designed in the interests of pure research. The value of such a system of check questions could be applied both to the problems of the inorganic as well as those of the organic world. They should be acceptable to workers with horticultural plants in particular at the present time as we are too apt to attempt work which has economic values only.

Dr. Allen's article in the February (1921) number of "Scientific Agriculture" in its general tone is somewhat critical of our methods of conducting scientific investigation. It may be an opportune time therefore, for research workers to more definitely select a type of problem for their attention which concentrates on work of a strictly research character and which has some relationship to all the varied departments of science.

Genetic problems which are still ahead should be thoroughly studied, not only as subjects to be undertaken within a special department of science for the sake of that science, but also as subjects having potential bearings on fundamental questions which in a genetic sense are germane to the entire cosmos!

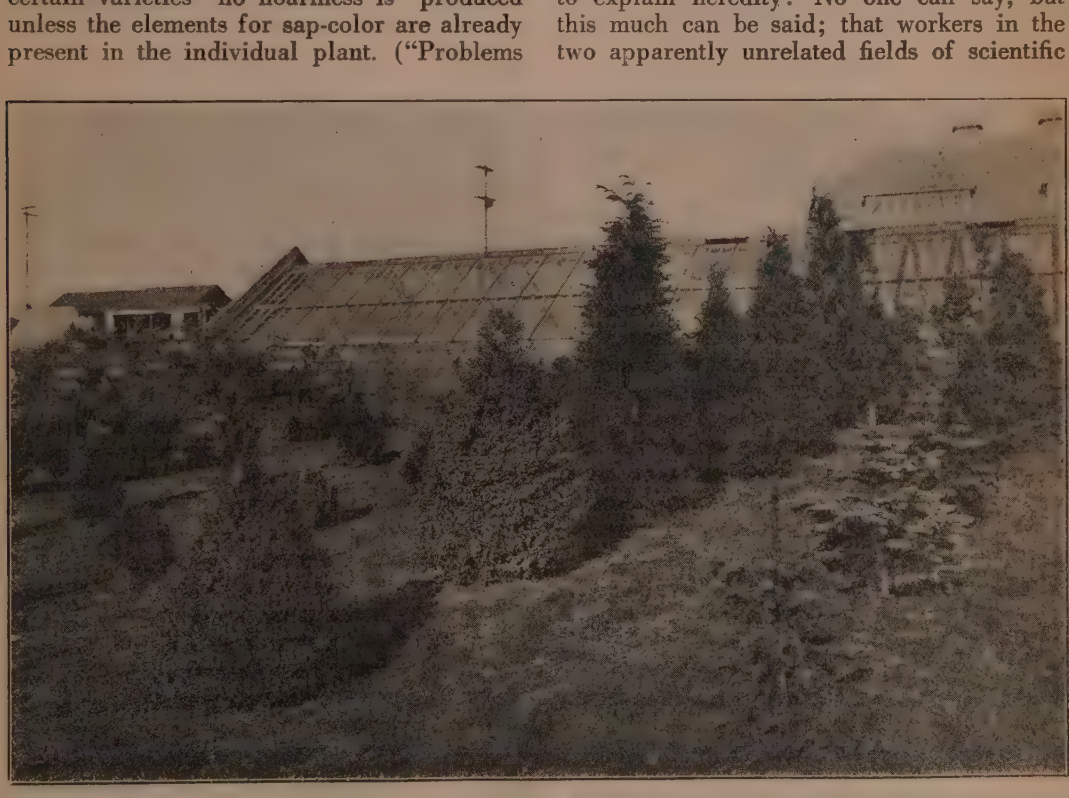
Quoting again from Lochhead—"the determination of the laws of heredity is perhaps the most important of biological enquiries for the reason that if they were fully understood the problem of the mode of evolution of organic beings would be solved. But this matter of the genetic relation between successive generations is most complex... however, much progress has been made in the study of heredity since Darwin's day, and several important laws have been discovered so that order is taking the place of chaos in some fields of enquiry". The progress referred to by Lochhead might then be greatly accelerated,—were it decided to systematically extend the enquiries of the biologist, and the *experimental work* of the biologist into the fields of the chemist and physicist. Why should we not have a symposium of experiments on several of the more fundamental genetics problems, similar to a symposium of papers on "Hardiness" read quite

A remarkable "standard" or "tree rose", growing near Vancouver, B. C. This rose is 15 feet high and is grafted on to "native stock", which made this remarkable growth in one year.

recently at a Convention of Horticulturists?

To illustrate what is meant by this suggestion to systematically enlarge the field of enquiry for any one particular problem, it may be stated that we scarcely think of heredity as such as existent in the inorganic world. Yet what force other than the hereditary could determine the many beautiful shapes of water-crystals, which on a frosty morning sparkle in the sunlight and change the sombre winter landscape for a few hours into a fairy-land of silver and white? These water-crystals, wonderful in their various forms and composed of but two elements, are as much a testimony to the law of heredity as are the leaves which on the trees later on assume hereditary forms and colors. Color we know, in both the organic and inorganic world is due to the same cause, and it has been shown that in the case of "Stocks" sap-color, and the physical property of hoariness on the leaves and stems, are so intimately related that in the case of certain varieties no hoariness is produced unless the elements for sap-color are already present in the individual plant. ("Problems of Genetics" page 84; also see Osborne's "The Origin and Evolution of Life" page 95.)

If color, why not form? Yet is the physicist looking for an explanation of heredity as such in the form of the crystal; is he working with the biologist to discover the same secret of nature? The biologist seeks this secret in the germ and somatic plasma of the cell; yet it may lie hidden in the crystals of water vapour! The shortness of the life cycle of a leaf-like crystal and the temporary character of its structure are no arguments that the same law is not responsible for form in both cases. Have we not a simple bacterium with an equally short existence cycle; and have we not a laboratory protoplasmic substance? The force undetermined therefore in one case may be the force which determines form in the other case, although in the case of plants the chemical constituents are more complex and forms more varied. Would a determination of this force help to explain heredity? No one can say, but this much can be said; that workers in the two apparently unrelated fields of scientific



Attractive Evergreen Shrubs which are not hardy in other parts of Canada flourish remarkably well in British Columbia. This photograph shows shrubs which were transplanted only six months prior to date of taking picture.

enquiry might very profitably combine their efforts in some definite way in the solution of this problem.

It may be remarked that this suggestion could be interpreted as constituting the basis for a "new theory of heredity and inheritance" and indeed it must be admitted that it may be so interpreted if desired.

Are we not ready to make some advance soon which shall be commensurate with the tremendous amount of detailed work that has been done in connection with many of the problems of research, and are we not ready to take another step forward which will be in conformity with the laws of progress? Workers who have the minor problems to investigate as well as those who are great masters of investigation must exhibit a larger faith in the oneness of their common problems. For all progress depends upon faith in each other and in eternal truth.

The unlikeness of many of the problems, their vast numbers, and the isolation of some of the workers all tend to bewilder and narrow the workers. All problems of research are but part of the great problem of evolution and life. It is given to but few men to see these problems in true perspective. To stand apart from them and see them as a great master sees things, or as an historian sees the relative value of historical incidents, is possible only for a very few. These few have bequeathed much to the scientific world during the past few decades in their work and writings, and now as the almost bewildering mass of detail is becoming too great for any one man to epitomize, a new task and purpose opens up for the rank and file of research workers. This task is to colloborate and concentrate their efforts on certain fundamental problems. As a result it is to be believed that out of the mass of material which now lies scattered over the research field we shall be able one day soon to raise a permanent and magnificent superstructure of research achievement which shall effect "more change in man's outlook on the world and in his power over Nature than any other advance in natural knowledge that can be clearly foreseen".

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Soil Surveys for British Columbia.

BY W. NEWTON

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Soil surveys may be defined as field studies of soils. They are primarily concerned with recording soil characteristics as they have developed by natural or human agencies. We have to recognize the fact that in the Province of British Columbia our fund of exact information upon soil characteristics is very scant. It is not necessary to go far afield to discover numerous examples that illustrate the economy of securing exact information as to our soil resources.

Land Settlement.

It is possible to point out innumerable examples, from practically all parts of the Province, of settlements on areas where the soil was of very low standard. The agricultural prosperity of a district depends primarily upon the quality of the soil, although climate, geographical position in respect to markets and transportation play a part. It is therefore a short sighted policy if we allow settlers, through lack of exact information as to the soils of British Columbia, to locate on poor soil areas if better soil areas exist in an undeveloped state. What has suggested so forcibly that it was lack of information as to our soil resources that was at least partly responsible, is that within short distances from settled areas on soils of low standard are better soil areas. Other evidence is in the size of the holdings. We would expect that the lower the standard of the soil, other factors being equal, the larger should be the size of the holding. Probably as the result of insufficient data on our soil characteristics there is little evidence that this principle has been considered in the land settlement policies of the past The errors in the land settlement policies of the past frequently cannot be remedied but

we as technical agriculturists can put on record our recommendation that more exact information on the soil resources of the Province of British Columbia be given to the future settler.

Soil Survey Work in British Columbia.

Those of you who are familiar with the Province of British Columbia will appreciate the great difficulties to be overcome in conducting soil surveys along commonly accepted lines in most districts of this Province, due principally to the great variation in soil types within small areas. Perhaps this will be better appreciated after an outline is presented of what we now recognize as a soil survey. Before doing so let us consider a few of our Provincial problems that should receive the attention of the technical agriculturists interested in the agricultural prosperity of British Columbia.

Southern Interior Irrigation Project.

The irrigated districts of the Southern Interior of British Columbia are rapidly growing in size and number. There remains much land that may be economically brought under cultivation under gravity systems of irrigation, but, you who are familiar with the topography of British Columbia will appreciate the fact that the spread of hydro-electric power will be the biggest factor in stimulating the growth of old irrigation districts and the development of new ones. The reason for making this statement is that the areas of land suitable for bringing under irrigation are comparatively small. The installation and maintenance charges on gravity systems of irrigation for small isolated areas are frequently so heavy as to preclude the utilization of the land. A great many of these areas will probably be economically brought under irrigation under electric pumping systems.

We have too many examples of abandoned irrigation systems for the welfare of agriculture in this Province. A number of these abandoned projects have been investigated and in many cases the failure of the project is traceable to the low standard of the soils brought under irrigation, although topography, climate, geographical position in reference to markets and transportation have played a part. However in our soil survey work in this Province we must correlate all these factors.

Although it is estimated by the American Association of Soil Workers that the cost of making a detailed soil survey will not exceed three cents per acre it is doubtful whether these figures would apply to British Columbia. Owing to the topography of this Province and the great variation in the character of the soil within short distances the cost in this Province would be higher. The topographical surveys alone that have been made in this Province have cost four cents per acre. It will be necessary for us to confine ourselves to special soil survey problems that illustrate the value of soil survey work so clearly that the public will learn to appreciate the value of this work. It is a factor that we must recognize that support for any line of agricultural work is always more easily secured when public opinion is in favor of the investigation. Strictly speaking a soil survey is a field study of soils, irrespective of the use to which the classified data is put. Owing to our high cost of conducting a detailed soil survey in this Province we must have a definite object before conducting a survey.

A survey of the prospective irrigation districts would undoubtedly be a profitable investment. For such surveys to receive the approval of the public they should be as complete as possible from the standpoint of the irrigationist. To make such a survey complete an irrigation engineer should work in conjunction with the soil man. The former should obtain data upon the source of water, the cost of applying, etc. The soil man's duties would be to describe and classify the soil areas that might ultimately be brought under irrigation. The complete report should furnish the data for working out a fairly accurate estimate of the cost of bringing under irrigation the area covered by the survey and the approximate value of the land. The classification of the soil into its various types should furnish the data that would enable the land to be divided equitably on the basis of true value.

Reclamation Projects.

The reclamation of areas by drainage introduces an important phase of soil survey work. As in cases of irrigation projects a reclamation project frequently requires a

large expenditure of money. There are large blocks of swamp land in the Lower Fraser Valley and elsewhere that can be profitably reclaimed. On the other hand, there are large blocks that would be very costly to reclaim and when reclaimed the soil would be of very low agricultural value. Owing to the favorable geographical position of many of these areas it is apparent that to determine whether these areas can be economically reclaimed is a problem that should receive our immediate attention. Swamp areas that may be economically reclaimed lie only a few miles from the city of Vancouver.

As in the case of the irrigation project surveys the reclamation project surveys should embody the engineering features of the work. A drainage engineer should work in conjunction with the soil man. The engineering problems are so interlaced with the soil problems that a soil survey would be of little value if it did not embody the engineering features. For example, the soil study of a swamp area may indicate that by maintaining the water table at a certain level the area would be suitable as meadow land, while a foot lower might create a condition whereby all kinds of crops grown on the upland soils of the same district may be produced. The additional cost of lowering the water table an additional foot may be too great to offset the improvement in the value of the land. The complete report should furnish the data that would enable an accurate estimate to be made of the cost of reclaiming the area and the approximate value of the land. As in the case of the irrigation project surveys, the classification of the soil should furnish the data that would enable the lands to be divided equitably on the basis of their true value.

A Lime Survey for the Lower Fraser Valley and Coast Districts.

The belief that a great percentage of our coast soils are acid has long been held but we have only a limited amount of actual data to support our supposition. There is still less data to support the view that practically all our coast soils would be benefited by an application of lime. The determination of this fact could be made at a comparatively low cost. This information would be included in a detailed soil survey but, as already mentioned the cost of making a detailed soil survey may prove to be too great to be immediately considered. The determination of the numerous convenient sources of agricultural lime content of our Lower Fraser Valley and Coast soils would enable us to utilize the lime to the best advantage. It would be easy to stimulate an organized effort to secure lime at a low figure if our coast soils are, as we suppose, deficient in lime.

Soil Surveys for Central B. C.

The reason why soil surveys, although theoretically important, are practically almost impossible in a great many sections of the Province is that the cost increases directly with the number of soil units or types within a definite area. Soil survey work along the lines discussed below will therefore be less costly in districts where large areas of a comparatively uniform soil type are found. A detailed soil survey in the Nechako Valley and other parts of Central B. C. will be economically feasible. Large areas of practically uniform soils are found in those districts.

An Interpretation of a Detailed Soil Survey.

The ultimate object of a soil survey is to isolate and describe a soil unit. In the laboratory a sample of thoroughly mixed soil may be called a unit. In the field the matter is much more complicated. Two surface soil samples may be practically identical but if their respective subsoil layers are different they cannot be classified as belonging to the same unit. It is only when the surface and subsoil layers are practically identical that the two soils can be so classified.

The Creation of the Soil Unit.

The first prerequisite in the mapping of soil areas is the creation of the soil unit. The soil unit is not established in a laboratory or from a mathematical computation. If it were our task would be easier because we would have exact premises to work from. The unit is formulated in the field from a record of soil characteristics. The unit is necessarily a group of characteristics that describe a definite soil area. What is considered a unit today may be broken into a dozen or more a few years from now.

The soil characteristic that was originally used to isolate a soil unit was that of texture. From the earliest times soils have been roughly classified as clays, loams, sandy loams and sands based on the size of the particles and the proportions of each size.

Although soil survey work has resulted in the standardizing of these terms the soil surveyor soon found that when soils were classified by textural units over a considerable area, the units were not all alike: they were not ultimate soil units. Other characteristics had to be recorded before the ultimate soil unit could be isolated.

At the present time soils are differentiated into textural units, this applying to the surface horizon, or the upper two horizons when the surface is very thin, but are further differentiated by those features of the soil profile that do not concern the texture of the surface horizons. In other words, we now recognize the necessity of basing a soil classification on an accurate description of the soil profile rather than on a description of the surface horizon alone. In both humid and arid districts the importance of this method must be apparent. If the surface horizon is a dark clay loam rich in humus it is very important whether this layer is three inches or three feet thick. Similarly if it is underlaid with a horizon of hardpan or gravel the importance of recording this fact is self evident.

The depth to which the soil profile should be described will vary with the field conditions. It will follow that the soils of an arid district must be examined to a greater depth than those of a humid district. In a humid district the surface horizons are of relatively more importance than in the case of an arid district. The statement frequently made that a soil in an irrigated district should be classified by the subsoil contains an important truth.

In a paper of this character it is difficult to lay down definite rules in describing soils. We may, however, enumerate briefly a few of the important observations. The texture of the horizons we have already discussed.

Notes on the color of the horizons, particularly the surface one or two, are important. It is suggestive of the vegetable matter content, degree of oxidation and other important soil characteristics.

Observations as to the structure of the horizons are recorded. If by texture we refer to the size of the particles and their proportions it will follow that horizons of identical texture may be decidedly different in structure . In one case the structure may be granular, in another compact and so on. The amount and character of vegetable matter may also affect the structure.

The significance of recording the thickness of each horizon is so apparent that it need not be discussed. In looking over a number of B. C. Land Surveyors' reports, those reports that recorded the thickness of the surface horizons were the only ones that gave an intelligent idea of the character of the soil.

Observations as to the relative arrangement of the horizons are frequently valuable. For example, the relative position of a hardpan horizon may prove to be an important characteristic in relation to drainage and the absorption of moisture.

Observations that may ultimately be included as significant in relation to soil survey work is the moisture content of soils and their absorptive capacities for water.

The chemical composition of the horizon should be recorded. In the past we have taken a core of soil for analysis 8 inches in depth irrespective of the horizons. Unless the analytic data is correlated with the information recorded in relation to the soil profile it is likely to be of little value.

At this point the necessity of the establishment of a central laboratory should be emphasized. No field man, however well trained, can complete a soil survey unless he can forward samples taken from the various horizons that he is describing to a central laboratory. The two characteristics that must be definitely established in a laboratory are texture referring to size and proportion of the particles and the chemical compositions of the soil horizons. In the case of lime some idea can be secured by the Truog, litmus. HCl. tests, but exact laboratory work must be done to check the field results.

Formerly the geology of the soil material was considered an important factor. Although this information is now considered of secondary importance it is still included.

The geology of the soil material frequently throws some light upon important soil characteristics.

We have discussed briefly the recording of the specific soil characteristics that must form the basis of soil survey work, but there remains the general information that must be included to complete a soil survey.

Topography.

The importance of including topographical characteristics in a soil survey is so self evident that it need not be discussed. Topographical survey work is being gradually extended in British Columbia but at the present time topographical maps of only a very small percentage of the Province are in existence. When satisfactory topographical maps are not available the compilation of these data must be included as part of a soil survey.

Climate.

Without an accurate record of the climatic conditions of the area covered by a soil survey it would not be complete. Owing to the topography of many sections of British Columbia there is a wide variation within short distances in climatic conditions. Existing meteorological records in all cases will not prove satisfactory enough for soil survey work.

Cover Surveys.

In the past "cover surveys" have been made in many sections of this Province referring to the vegetation. Such data should always be included in a soil survey report. In the case of virgin soils the data may prove to be suggestive evidence of the agricultural value of the land. For example, a luxuriant growth of sage brush has long been considered as indicative of a good soil when water is applied. When land is under cultivation the observations under this head would refer to the kind and character of the cultivated crops. The information recorded under this head may be called supplementary evidence. Sometimes this information may prove to be of no value but in the case of most soils a correlation will be found to exist between the vegetation and the character of the soil.

Experimental Results and the Soil Survey.

There is need of closely correlating our experimental results with soil characteristics; in other words, of utilizing soil survey data in interpreting experimental results. In the past in the Province of British Columbia we have published figures on experimental results without even an attempt to describe the soil characteristics of the area on which the experiments were conducted. Until this is done we cannot hope to arrive at satisfactory conclusions in regard to the comparative merits of varieties and strains, but particularly is this true in the case of fertilizer experiments.

In future, particularly in regard to extension experiments not only will the soil on the specific location be described but the distribution of that particular soil type will be recorded. It will follow as being economically sound that extension experimental stations will be located at points where the soil is representative of the predominating type for that district.

A. A. A. S.

The American Association for the Advancement of Science, with which the C.S.T.A. is now affiliated, is an organization of some 12,000 members. An effort is now being made to enrol new members in Canada, among members of the Canadian society.

Agricultural science is clearly one of the most important among the several scientific branches, and agricultural workers contribute more directly to human welfare than do most other devotees of science. Furthermore, the position of the trained agriculturist in every community is very exceptional from an educational point of view. They enjoy a particularly intimate relation with other men of science on the one hand, and also with the public, on the other hand. Popular understanding of the meaning of scientific research, and popular appreciation of scientific truth are very greatly influenced by agricultural graduates and professional agriculturists generally.

Section 'O' of the A.A.A.S. is the one devoted to agriculture. Full particulars can be obtained from the Permanent Secretary, Dr. Burton E. Livingston, Smithsonian Institution Building, Washington, D. C.

Problems in Agriculture as Related to Dairy Bacteriology.

WILFRID SADLER

Professor of Dairying, University of British Columbia, Vancouver, B. C.

The science of Bacteriology is one of the younger children of a family of ancient lineage. For it is but sixty to seventy years ago that Pasteur was pursuing his first researches into the processes of fermentation, and founding, as we conceive it to-day, the science of Bacteriology. The special branch of this science with which for the moment we are more particularly concerned, Dairy Bacteriology, or the Bacteriology of Milk and Milk Products, has received at least its quota of attention and devotion during the evolution of the science of Bacteriology in the broad and major sense. I cannot do better at this point than to refer you to the paper presented in May 1919 to the Royal Society of Canada, by Dr. F. C. Harrison, on 'Dairy Bacteriology and its Earlier Workers.' In reviewing in particular the work of Kirchenus, Fuchs, Pasteur, Hall, Lister, Cohn, and Robert Koch, it is shown by Harrison that the cumulative effect, followed by the work of a veritable host of investigators, has been the establishment of new principles in modern dairy practice. Of the leaders and seers in this host of investigators we must be content to consider those at this time to whose activities the advances in the science of Bacteriology as applied to dairying are more especially due. We are faced with a galaxy of eminent workers. The reviewing of the literature is not to be the function of this paper. It would seem almost invidious to emphasize results emanating from any of several laboratories in particular. It must be accepted, however, that in Europe, including Great Britain, the work of Duclaux, Von Freudenreich, Weigmann, Lloyd, Gorini, and Jensen, to go no further, has been of the most profound significance with respect to its effect upon the industry of dairying; while the contributions of these same investigators to systematic science have been and are of the highest order.

On the North American Continent, within the last twenty to thirty years, a succession of distinguished workers in bacteriology has arisen. To us, it is but fitting that a recognition of the pioneer services of H. W. Conn in the United States, and of F. C. Harrison in Canada, should be accorded. For in the main, it has been Conn and Harrison in their respective countries who have crystallized and defined the bacteriological sense in its application to the science and practice of Agriculture; and in a very definite degree to the science and practice of Dairying. The researches of the investigators cited, and of the great army of their eminent contemporaries, have initiated and established the dictum that dairying is truly a fermentation industry.

The penetrating light of scientific truth has been thrown upon the phenomenon of the souring of milk. In large measure the bacterial agencies primarily responsible for this and many other phenomena have been discovered, and classified.

Researches on the bacterial flora of the normal udder af the cow have proceeded since the days of Lister. The channels through which bacterial contamination arrives in milk have been investigated with a thoroughness compatible with the dire necessity for such investigations. Researches into the relation of bacteria to cream and butter have been pursued through the successive decades. The responsibility of bacteria and moulds with respect to the successful manufacturing and maturing of cheese has provided problems worthy of the steel of the most profound and devoted worker.

The literature of dairy bacteriology, or as I prefer to conceive it, the literature of the new dairying, is a contribution of no mean order to the advancement of science. It is, moreover, a charter of freedom from the empirical, a guide and a lamp to those engaged in the industry of dairying. Much has

been done. Much yet remains to be accomplished. Problems have been solved. An array of questions still awaits the genius of the enquirer.

It has seemed that to discuss the work upon which we are engaged is the most logical method of presenting to you our conception of the researches most needed to assist the advancement of dairying in British Columbia. In the Department of Dairying it has been made possible for the staff to pursue such researches and investigations as would best seem to be of service to the public, and to the dairying industry of this Province in particular.

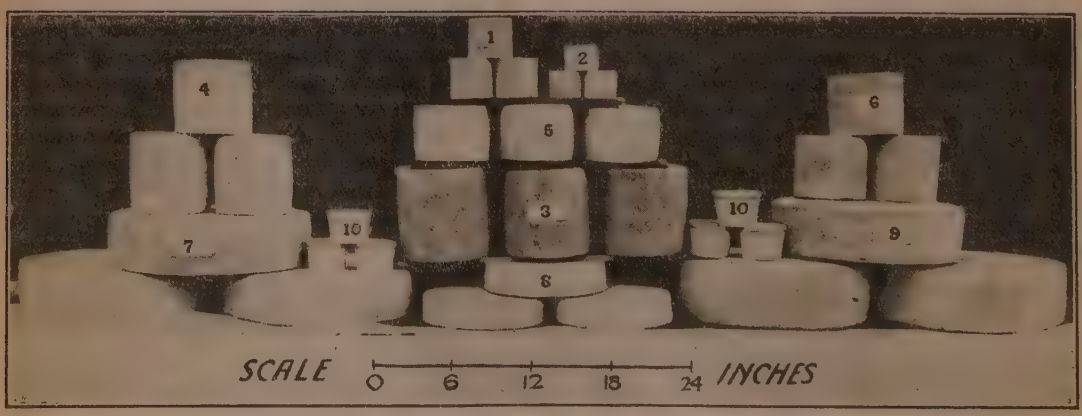
The Period of Usability of Milk.

The investigation into the 'Possible Period of Usability of Milk' has been one of the primary interests of the Department of Dairying from the date of its inception. We consider this work to be the basic research which it is desired to pursue to the utmost limit of our resources. In the paper presented by Miss Mounce,* a reference is made to the report on the preliminary phases of the work. The present trend and the ultimate hoped-for goal of the investigation have been indicated. Miss Mounce has touched upon the results obtained by her in the more recent part of the work, and she has pointed out that pending the accumulation of further data, publication of the results is being withheld. She has noted briefly the laboratory methods at present in vogue, and the necessity for the incorporation of additional procedures for control.

It is not my purpose to assail you with vain repetition. For the moment I desire to project the discussion along one particular avenue. Embedded within the possibilities accruing from the data revealed by this research—and the embedded possibility is almost accessible, for the paraffin is near the melting point—is the experimental proof which should establish in an uncontrovertible manner the necessity for the adoption in practice, of grading the price of milk on the bacterial content of the same. Exhortations to the producer to market a product having a low bacterial content, a milk having a 'maximum period of usability' must be backed up in terms of cash. A cash value must be put upon the absence of bacterial flora.

In so far as in us lies, the investigation here under discussion will be pursued to the end that an addition shall be made to our store of scientific knowledge: that the data accumulated shall be at the service of those engaged in the attempt to produce a better and a purer milk, and that experimental proof may be secured which shall assist in the consummation of the practice of grading

* To appear in a later issue of Scientific Agriculture. Ed.



Varieties of Cheese made by the Department of Dairying, University of British Columbia.

1. Kingston
2. Kingston Half Size
3. Wensleydale
4. Cheddar
5. Farm Cheese
6. Cheshire
7. Derby
8. Port du Salut
9. Gruyère
10. Cottage Cheese.

the price of milk on the bacterial content of the same. The exploring of the divers avenues which the investigation in its various stages has of itself suggested, will provide more work than can feasibly be attacked for some time to come. It may be that in due time it will be possible for such work to be strengthened by contributions on the part of others, of labatory data secured in parts of the province in which members of the C. S. T. A. are pursuing their several activities.

The Bacterial Content of Graded Butters

An investigation into the possible correlation of the grading of butter with the bacterial content of the same has been progressing since July of 1919. This investigation has been made possible by the support of the Honorary Advisory Council for Scientific & Industrial Research, Ottawa, on the one hand, and by an especial consideration on the part of the University authorities on the other hand. Mr. R. L. Vollum was associated with me in the work for the two years prior to his departure for Oxford University as elected Rhodes Scholar from this Province. It has seemed to us to be a justifiable premise that underlying successful grading, there must be an appreciation of the bacteriological factors which influence the quality, the flavour in particular, of cream and butter. The co-operation to the fullest degree of the Provincial Dairy Commissioner—Mr. Henry Rive—has made possible the using by us for our laboratory determinations of a large number of exhibits of butter which had been submitted to official grading competitions. The report of our work is in process of compilation. Until the publication of the report, it would not be sound ethics to discuss the findings of the investigation. I will, however, indicate one or two of the more salient features of our results.

Of the three hundred and fifty-two cultures isolated, we have retained one hundred and fifty-nine strains after preliminary determinations. The detailed studies of the one-hundred and fifty-nine strains are recorded. The classification of the organisms is proceeding. We find stapheococci, micrococci, streptococci, sarcinae, spore-bearing rods, non-spore-bearing rods, torulae and yeasts. The strains have been submitted to an experimental laboratory process of pasteurization duplicating as nearly as possible the processes in vogue in the respective creameries. A high percentage of the strains were killed. We are led to suggest that the results indicate re-contamination by bacteria subsequent to the process of pasteurization.

Another phase of the same investigation has concerned itself with the deterioration of butter subsequent to the product having been graded as of high quality. Of two hundred cultures secured, eighty-one strains were retained and submitted to detailed studies. We made suggestions based on the results of our work and nine months later we were advised that no recurrence of the deterioration had presented itself. One very important contributory factor to the deterioration proved to be the water supply used for the washing of the butter.

The practical application of our findings is that the processes of manufacture and management adopted in the creameries permit of recontamination by bacteria subsequent to the pasteurization of the cream. Since the period referred to above there have been recurrences of deterioration in the quality of graded market butters. And in view of the importance of the creamery butter-making industry in this province, there is urgent need for the continuation of work such as that upon which we have been engaged.

Cheeses and Cheese-making.

We are proceeding with an enquiry into the bacterial flora of the "Kingston Cheese.' Mr. C. D. Kelly, a senior student, under my direction has obtained sufficient data to throw some light on the changes which take place during the maturing process of the cheese. Further, the results thus far on record serve to indicate the desirability of continuing the work. This we hope to do. In producing the 'Kingston Cheese" the general principles underlying the successful manufacture of cheeses of the hard-pressed type are subscribed to. Yet the cheese is ready for consumption ten days after making. The development of the ripening process is for these reasons a matter of scientific interest; and information relating thereto will be of material assistance when applied to the procedures involved in the making of the cheese in practice.

Wensleydale Cheese.

Professor Golding of this Department is engaged on an investigation into the possibility of making a typical blue-veined cheese of the Wensleydale type in our own province. His work is not yet ready for publication. The indications are definite that success in the project is assured. Studies on the microflora of the cheese will require to be conducted.

Camembert Cheese.

It is to be desired that in the interest of the dairying industry of this province, work shall be carried on with regard to the methods of manufacture and the processes of ripening involved in the preparation for market of the Camembert Cheese.

The consummation of the work outlined in the preceding pages, and the exploring of the various avenues which the investigations cited have of themselves suggested, would seem to us to be the major fields for research for some time to come. It would require a separate paper to deal with what seem to be even the more important aspects of the developments suggested by our work in the fields we have attacked already.

One aspect of the work however must be noted at this stage. It is a matter of urgency, from the point of view of the dairying industry, that work shall be proceeded with on the various methods which hold promise of making possible the instituting in practice of the buying and selling of milk on bacterial grade.

Conclusion.

In conclusion let me say a word as to the application of the findings of research and investigation. It would seem that dairying research should have at least two main objects in view:—(a) the increasing of our store of knowledge by making a direct contribution to the world of science, and (b) the advancement of the industry. It is with reference to the latter of these two objects that I would conclude. In his paper on "Bitter Milk and Cheese' published twenty years ago in the Centralblatt für Bakteriologie, Harrison included the following comment..... 'because neither patrons nor makers have yet begun to realize the close relation of bacteria to dairying in all its branches'.....Twenty years have passed. During the intervening period, the industry, in many respects, has been revolutionized. Certain of the findings of the laboratories are incorporated in the practical procedures of the dairy. To-day the theses of research workers are looked upon with favour. It does seem, however, that at times too much caution in the application of these theses has been observed; and the industry has not reaped the benefits which otherwise would have accrued. In the fullest sense, the findings of the laboratory have not yet been accepted as the working hypothesis in the practice of dairying.

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Bio-Chemical Problems in Agriculture with Special Reference to Fruits.

A. F. BARSS.

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From the results of many investigations in the past it is more than clear that much of our failure to attain desired results in plant behaviour or performance has been due to the lack of sufficient knowledge of the plants themselves, of their general make-up, of how they live, grow and fruit, and of how plant performance may be altered by changes in the factors affecting the plants.

We are past the stage where we invest plants with a personality and, on finding that a plant partly girdled has set a heavy crop of flower buds, we no longer account for its action on the ground that the tree, "thinking" it is about to die, and "desiring" to ensure the perpetuity of the race, the existence of which it "feels" is threatened in its own injury, "plans" for abundant re-

production. We now know (or think we know) that the plant's performances are hardly a matter of providence or personality, of control of mind over matter, but merely the natural outcome of conditions as they exist within the plant. In other words the tree or plant is at all times in its life the outward expression of an inward condition, a condition brought on because of a definite arrangement of influencing factors; a condition capable of being modified internally (and hence in the external expression) as these various factors may have greater or less proportionate bearing on the plant.

The plant then is what it is, not beause it wants or does not want, but because it can't help itself. It is a definite result brought on by definite causes.

Bio-chemistry, or Phyto-chemistry as it might well be called when being definitely applied to plants, is that branch of chemistry which deals with the life processes of plants, with the constitution of the various compounds in plants, together with the conditions under which these compounds undergo changes producing thereby varying responses in protoplasmic activity.

In all bio-chemical investigational work relating to horticultural plants, then, attention is directed largely to a more detailed study of plant processes, especially to matters relating directly to plant nutrition, since many of the differences in plant responses seem fundamentally attributable to corresponding changes in the food supply.

There is no desire at this time to enter upon a discussion of the many interesting and valuable facts which, recent researches having brought to light, have affected and will continue to affect the fruit industry most markedly. Rather is it intended, from the few speculative remarks which follow, to emphasize not what has been done but to stress "needed lines of Agricultural Research and Investigation in the Province" and "to provoke discussion".

An oft-repeated criticism has been leveled at Research. Not realizing that facts are facts regardless of how obtained and that one fact or one "know" is bound to be of greater value than several ideas or several "thinks", would-be opponents of research work have tended to discredit this type of endeavour, preferring the average field experiment even though this, as we know, may be constantly subjected to so many complex and non-measurable conditions. But just because an attempt to understand plant activities is termed Research and such investigations are carried on under so-called "abnormal" con-

Okanagan Orchard Scene, showing method of furrow irrigation.

ditions in a laboratory, it does not follow of necessity that the findings cannot be of practical, commercial value to the farming industry. Too little does the farmer, who is to benefit, realize the importance, in investigational progress, of having experiments carried on under controlled conditions, so that in the summation of results it will be possible (as is rarely the case under field conditions) to know to what one factor to credit the change in response and to make a fair estimate as to the probable means of producing other allied changes.

Field experiments unquestionably have value. The "cut and try" methods of arriving at a successful system of pruning, to mention but one example, did effect large improvements in pruning practices. But those empirical methods of the past failed to explain the reasons for the responses obtained; a gap which researches in bio-chemistry filled, resulting in a tangible, reasonable explanation for the phenomena of tree responses, thus paving the way for more rational orchard pruning practices.

The field experiment, it might also be added, will continue to have its place. Plant researches may establish laws and make possible the enunciation of principles, but quite naturally will it be left to carefully planned field experiments to test the practical application of these newly discovered laws under changing environmental conditions. Yes,—and even field experiments, pure, unadulterated and entirely divorced from any idea of establishing laws, have had and will have practical value.

Bio-chemistry is essential to the fruit farmer. Not that he will always realize its importance and give the credit where it is due, but fundamentally where fruit problems need solving the trained plant chemist will often be the one to whom we must turn for the solution.

Many most interesting and valuable investigations have already been carried on which have thrown much light on the fruit growers problems. There are, however, many other lines of investigation which might well be followed, in the hope of finding answers to the many puzzling questions confronting the fruit farmer today.

The ideal toward which every fruit farmer is striving is to obtain year after year from each plant or tree the largest crop of the finest fruit possible. Not reaching this ideal, the natural question is—what can be done to improve matters? Just what is wrong is often hard to say. The solution may be found in the naming but often the trouble is recognized only as an undesirable effect for which the named cause is lacking.

While it is realized that considerable work has already been done in attempting the solution of some or all of the problems which are about to be mentioned, yet it is thought that a brief presenting of these problems will be worth while.

Certain kinds or certain varieties of fruit for which the market seems to show a decided preference are at present grown in relatively limited areas, due, we are told, to a lack of hardiness. This question of hardiness has been made the subject for study by many investigators, and much valuable evidence has been forthcoming as a result of their efforts. So far, no one has found an answer capable of universal application throughout the plant kingdom. Such a goal may never be reached. The question arises, —if it were known completely just what, in plants, constitutes hardiness, and how the degree of hardiness might be increased, would it not be possible to extend the present limits for growing certain fruits for instance, and so add to the prosperity of the country? The plant breeder might justifiably say that this would be a problem for him,—to develop through hybridization a new variety to suit the purpose. This might be entirely possible and we do know that this type of breeding work has met with fair success within certain limits where it has been attempted. But when we have bred up such a variety we still have not the answer to our problem of what is responsible for hardiness and how it may be increased. To have the answer might either make the plant breeder's work unnecessary or, by knowing the plant indications correlated with hardiness, might simplify considerably the selection of suitable parents for crossing. What an additional advantage it would be were it possible, from a fuller knowledge of hardiness and the factors influencing it, to be able definitely to detect hardiness or identify the conditions limiting hardiness, so that once identifying these conditions in a plant or the corresponding conditions in a

locality, there would be no further waste of time and money trying to succeed in growing certain plants where our knowledge of conditions might tell us it would never be possible to do so. This is, of course, assuming that it were possible to reach the desired complete understanding of this quality, of hardiness. Or again, surely it is not too much to hope that we might in time correlate within certain limits, proved internal conditions with cultural methods or with soil and climate variations so that in farm practice, by such artificial means as pruning, irrigation, using cover or inter crops, as the need might suggest, it might be possible almost at will to induce in plants that internal state known by its effect as *hardiness*.

Another growers' problem, especially among tree fruit growers, is that one often referred to in a general way as the problem of self-and inter-sterility, and the closely associated ones of setting or dropping of fruit. Climatic and soil conditions may appear ideal for fruit, the trees may blossom well and show conditions suitable for fruit bud formation, and yet for some reason the amount of fruit which actually reaches maturity seems much less than conditions would justify. Bio-chemistry may not be able to lead the way to a solution of these problems, but were it possible definitely to state to a farmer that as a result of latest investigations on sterility, its causes and effects, he could never expect to grow a certain variety on his farm without supplying a certain definite other variety for a pollenizer; or that it will never be possible for him materially to improve the set of fruit because his peculiar local conditions produce a certain chemical response in his plants or in the variety he is attempting to grow, then at least something definite would be known. Even if this knowledge might entail a complete replanting, that would be preferable to continuing to grow kinds of varieties which never would give satisfactory crops,—never would, because research might have proven it physically or chemically impossible.

Another neat problem, the solution of which the Bio-chemist may continue to attempt, is the determining of the conditions in plants responsible for resistance or immunity to the various plant troubles, those caused by insects or disease or those other troubles so willingly but indefinably grouped, for lack of a better description, under the general head of physiological. It is true that plant breeders have succeeded among certain fruits and vegetables in breeding

Clean Cultivation in a Kootenay Orchard.

disease resistant lines; plant explorers have introduced resistant or immune species or varieties from other sections, but those efforts while good in themselves, do not solve the fundamental problem of what actually constitutes resistance or immunity and, leading out from that, whether or not it may be induced in existing varieties by means within our control.

And after fruits are harvested another important Biochemical problem comes to hand. Experience tells us that fruits and vegetables will not keep indefinitely in the condition in which we find them immediately after harvest. There is a more or less rapid general breaking down and deterioriation which storage experiments have attempted to overcome or delay. While *empirically* progress has been made which has improved the practical results, *fundamentally* too little is known as to the internal changes taking place within the fruits and how these changes may be affected by modifying external conditions which in turn alter the relation of the internal arrangements producing the internal condition.

In constructing and operating storage plants too much attention has been given to doing something or providing certain conditions which it is expected may result in longer keeping. Too little thought has been given to the fact that all fruits are living and that mechanical storage conditions must be adjusted to suit the life processes going on in the fruits after harvesting with the practical end in view of maintaining freshness, flavour and full food value. This problem of storage is closely linked with that other problem of proper time of harvesting fruits, both of which questions and many others might more readily be settled were we to understand fully the chemical changes which take place in the fruits during maturation. As Oregon found a correlation between the internal condition of certain varieties of pears and the resistance of the epidermis of the fruit, thereby enabling them by a mechanical pressure test to obtain an accurate indication as to the best time to harvest pears, so it might not be expecting too much to hope that with a fuller knowledge of the ripening processes of fruits we might with practice be able to state when and how to regulate our controllable storage factors of temperature, humidity and ventilation, to suit the corresponding internal changes in the fruit.

And these are merely a few more or less random statements intended to bring to your attention but four important Bio-chemical problems in agriculture with special reference to Fruits.

Needless to say, there are any number of others which might have been mentioned—(and even the problems mentioned may be nearer solution than we now think). In the past we have had some fair understanding of the external factors affecting the various conditions assumed to exist in plants. Through gross observations and experimentation, progress has been made. For fullest value, however, and for best results it is essential that we have an understanding of the internal factors and their effect on the nutrition of the plant, variations in nutrition seeming in the large to be back of cell and tissue structure and of all plant responses. This knowledge can often better be gained through laboratory studies which precede the field studies (when provision can so be made), rather than as in the past, letting field studies precede the laboratory work.

With a more detailed knowledge at hand of plant chemistry and physiology, enabling us definitely to detect conditions as they exist in plants and with an identification and knowledge of the various affecting stimuli, with their corresponding responses in plant activities, an attempt at practical application to grosser field conditions may be made in an endeavour to learn the limits of application with respect to the several kinds and varieties of fruits and vegetables, or under varying environmental conditions such as soil and climate. By understanding internal plant conditions and by correlating the internal condition obtaining at any one time, with the corresponding observed external conditions existing at that time, there will be greater likelihood of rational application of farm practices than has been possible in the past.

Bio-Chemical Problems in Agriculture as Related to Food.

BY WILLIAM H. HILL

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To introduce my subject I shall quote from the presidental address of F. S. Harris at the 13th annual meeting, 1920, of the American Society of Agronomy, who said;—"The welfare of mankind is intimately bound up with the world's food supply. Not that man can "live by bread alone", but he is unable to devote himself to the higher phases of an advancing civilization if he is conscious of the gnawings of hunger. Since the shortage in various food products during the war, people generally have taken a much keener interest in the whole question of food supply".

The aim of science is to interpret all nature in terms of our own familiar sensations and activities. In Biology, we investigate the circumstances of lives like our own, and proceed to structures more and more remote from ourselves, until the analogies are reduced to the two fundamental motives which, according to Schiller, keep the world machine in motion—hunger and love. And when those characteristics fail us, when the number of organisms becomes too vast or their size too minute to enable us to detect anything but blind chance in their life-history, then we enter the domain of Chemistry.

The faculty for research or questioning is probably an inherited tendency in all human beings; it is usually more pronounced in our early life than at later periods. The child wants to know more, to enlarge and make more definite their experience. The persistency and development of this spirit of enquiry or curiosity depends upon subsequent training and environment of the future researcher. Unfortunately many of those individuals who are equipped by hereditary tendencies, that have been fortified by proper scientific training and environment, are forced from the fields of agricultural research by the demands of our present democratic system. It is this system that clamours for the so-called efficient classification into which all scientific workers must fit irrespective of their qualifications and training. Occasionally a research man is allowed to function in order that he might be exploited to satisfy the selfish desires of some other individual; sometimes he is praised profusely and left to starve both in body and spirit, for he too often assumes in practice the attitude of "having food and raiment let us be therewith content."

What is the task now under consideration? It is to overcome the traps of nature by the utilization of the closely related sciences of Biology and Chemistry for the elevation of Agriculture from the status of an empirical art to that of a definite science, and for the purpose of increasing the production of foodstuffs.

What is food? Food may be defined as that which, when eaten, serves by digestion and absorption to support the functions and powers of the body, by building up the material necessary for its growth and supplying its waste.

Our food is really potential energy and the body absorbing it is a chemical laboratory, in which that energy is transformed from one form into another, and substances are destroyed—analysed—and rebuilt—synthesized—to suit the requirements of the organism.

The frequent use of our ordinary foods has made us so familiar with them that we seldom ever pause to consider how really complicated they are, and we do not often appreciate the innumerable processes that are every day being carried out in the great organic laboratories which we all possess; yet a thorough understanding of them takes us far afield not only into the realms of Chemistry and Biology but into the studies of Physics, Bacteriology and Physiology as well.

The fundamental importance of applied chemistry and biology to the practice and study of agriculture is reflected in the per-

sistent demands which call for the application of more intelligent scientific methods, in order to stimulate, control and conserve the economic production of foodstuffs.

Under prevailing economic conditions it behooves us to examine our food carefully to make sure that not only is it sufficient in quantity and quality of the protein, fat and carbohydrate content but that it contains all the necessary accessory factors including vitamines, mineral salts and so forth, which are all essential for the maintenance of the health of the nation.

The subject of vitamines opens up a wide vista for research in the field of biological chemistry; up to the present only a very vague idea of the wide distribution of the various vitamines in nature can be formulated.

The manner in which the vitamines exert their influence in the body is still veiled in an atmosphere of mystery which needs clarifying.

The processing and canning of various food stuffs requires the question of the thermo-stability or temperature tolerance of the vitamines to be answered.

The proper feeding of milk cows, in winter, is important having regard to the vitamine content of the milk produced, as it has been shown that the milk of cows kept on grains, roots and no fresh green vegetables gradually loses its antiscorbutic properties due to the absence of vitamines. This problem of feeding cows to produce a milk containing a large quantity of vitamines will command the cooperation of the Agronomist, the Chemist and the Animal Biologist, the objective being to produce the plant with the high vitamine capacity to feed the cow that will produce milk with the required proportion of vitamines.

There is little doubt that in the very near future the consumer will be purchasing his milk supply by the pound instead of by the quart, therefore attention should be directed towards the improvement of the methods for manufacturing powdered whole milk with a view to enhancing its keeping qualities and the preservation of the vitamines.

The carbohydrates are usually considered to be the most readily digested components of our food; they are supplied in the form of milk sugar and the various sugars, starches and gums from plant juices, cereals, fruit and vegetables. Probably wheat, potatoes, cane and beet sugars are the most widely used materials as a source of our carbohydrates on this continent.

Although the wheaten loaf is the evolutionary product of numerous centuries of baking, we still find that "the staff of life" presents to the researcher many problems which reveal themselves during the process of making. It has been estimated that the housekeepers of America to-day make seventy per cent of all the bread, yet the remaining thirty per cent made by the bakers involves a capitalization of over two hundred and seventy millions of dollars. Anything, then that the Biological Chemist can disclose to improve the present day status of the art of bread-making is of great importance and interest to agriculture.

The complex nature of flour gives us a large field to explore. For instance the raising power of bread may depend on the per cent gluten but all glutens have not the same capacity to make a satisfactory loaf of bread. We find that the glutens of rye, maize, rice, barley, buckwheat and wheat all contain varying quantities of two substances, chemically combined or mechanically mixed, we do not at present know, called respectively gliadin and glutenin. Wheat contains by far the highest per cent of gliadin and when associated with the correct proportion of glutenin seems to constitute the ideal framework of the loaf. Here is a field of endeavour for the Agronomist assisted by the Biologist and the Chemist, to evolve a wheat plant or other grain producing plant which will, when milled, have the correct proportion of gliadin to glutenin in the gluten. But this combination is only one factor in this complicated food product. Many problems are awaiting us; one other of immediate importance might be stated, namely, that of determining the causes of ropiness in bread with reference to the source of flour contamination.

If we continue to consider bread problems we find that the yeast required to make the loaf further complicates our troubles. From the time of Pasteur yeast has been the subject of innumerable investigations, but even to-day we are only on the fringe of knowledge regarding these "plants" There are many different strains of yeast; What are the best

for bread? What is the nature and proportionate quantity of the ideal soluble protein for yeast food? What mineral substances are best to accelerate the action of yeast? What is the actual action of yeast on the gluten?

Our next largest source of carbohydrates, chiefly in the form of starch, is the potato. Our lowly potato has its question box, for example, what shall we do with the little ones? Can we not make the tubers of a more uniform size and quality by proper biological and chemical control? What use can we make of the potato top? Shall we allow them to rot in their "free state" or shall we find an agricultural use for them?

Renewed efforts should be made to stimulate the production of sugar beets; this crop has an important place to fill in Canadian Agriculture. Further study of the plant and its requirements for sucrose production should engage the time and attention of some of our researchers.

As the carbohydrates form the most important and abundant class of constituents in our fruit and vegetable foods, they therefore furnish a large and significant portion of our food supply.

The economic utilization of the surplus fruit and vegetables, more especially the low grades and culls, presents an opportunity for the searcher after truth with many good chances, such as;—

(1) A critical study of the manufacture and handling of dessicated fruits and vegetables with a view to maintaining the natural flavour and colour, as well as preserving their carbohydrate and vitamine content.

(2) The development of a satisfactory process of manufacturing and clarifying of pectin obtained from cull apples and apple waste.

(3) The study of the chemical and physical composition of pectin and its estimation in manufactured fruit products.

(4) The proper preparation and handling of fruit juices for beverage purposes, such as cider and loganberry.

(5) The possibilities of utilizing the fruit culls, of British Columbia, especially peaches for the making of vinegar.

(6) The discovery of sources of citric acid from fruits other than citrus fruits.

(7) The utilization of some of the acid soils of British Columbia for the culture of blueberries.

Many other problems regarding fruits and vegetables might be tackled. The chemical and biological causes or factors relative to the coloration and ripening of fruit are still open questions.

Transferring our attention to another important and essential component of our food, the proteins, we find a large and varied sphere of activity for investigation.

The term protein includes an immense number of nitrogenous bodies consisting, according to our present knowledge, essentially of combinations of a-amino-acids and their derivatives.

The proteins in one form or another exist in nearly all natural foods both animal and vegetable. Those available for food purposes are supplied chiefly by the flesh of meat and fish, by milk, cheese, and eggs and in the vegetable kingdom by seeds, nuts and vegetables, especially legumes.

Our knowledge of many of the animal products used as food must be regarded as fragmentary. Even cow's milk is still a liquid of unlimited possibilities for the research-worker. The production and manufacture of the nation's milk supply is an extremely important question, not only from an economic standpoint but from an agricultural aspect; the solution demands the services of the Chemist and the Biologist. It must be observed that milk and other dairy products are much cheaper sources of protein and energy than other foods of animal origin. It is, therefore, a sound economic policy to encourage the breeding of dairy stock rather than beef stock, because milk affords a much greater supply of proteins, fats and carbohydrates, as well as of mineral salts and vitamines than can be provided in the form of meat.

Referring more specifically to some of the Bio-chemical problems of research upon milk and dairy products, I would suggest the following;—

(1) The investigation of the rôle of carbon dioxide, both natural and additional, in milk products. Some work has been done already, notably the development of the process of Frankerizing of milk and ice-cream, but much more might be accomplished.

(2) The sterilization of milk, intended for cheese making and the preparation of infant's food, by means of electricity. The determination of the other factors, besides heat, which function in this process.

(3) The development of a method for evaporating milk without altering its taste and chemical composition, as well as producing a sterile and live vitamine commodity.

(4) The discovery of a means of artificially curing Cheddar cheese, with a view to enhancing its keeping qualities and flavour and also shortening the length of time now required for curing.

(5) The breeding and selecting of Holstein, Shorthorn and Ayrshire cows with the objective of intensifying the factors influencing the production of a deeper coloration of milk during the winter lactation period.

Another valuable source of protein and an important factor in the diet is the egg of the domestic hen. We find as the density of population increases, especially in the urban centres, the problem of securing fresh eggs becomes more and more acute.

This has been rendered more intricate by the fact that the greatest part of the annual lay is secured during the months of March, April, May and June. This makes it necessary to hold over, either by cold storage or preservation, the abundance of these months against the want of the others. It has become of much importance to determine what factors are important in the keeping of this food product. The improvement of the albumen of eggs and the factors controlling the density and viscosity of the albumen, the objective being to increase the carrying capacity of the egg. The increase in the strength of the shell to decrease breakage, and the improvement of the permeability of the shell to fortify their resistance to bacterial action.

A critical study of the enzymes in eggs as a means of determining their age and history. The production of dried or desiccated eggs has become a well established industry, especially in China; it might perhaps be possible to develop such an industry in British Columbia when all the hens in the province are laying their 365 eggs per year?

The fats in human food are supplied by milk and its products, by the adipose tissue of meat, and in a slight extent by the oil of cereals, nuts and by edible plant oils.

Probably butter has been the subject of more researches than any other of our sources of edible fats, nevertheless, there are many things yet that we do not know in reference to many of the biological and chemical factors which enter into the manufacture and handling of this valuable food material.

The whole question of the deterioration of butter is a vexed one, especially the cause and nature of rancidity; this is also applicable to all edible fats and oils. The degree of tolerance of rancidity in fats and oils, both for human and animal consumption, is a live topic for investigation.

The digestive value of hydrogenated oils, especially those used in the manufacture of butter substitutes demands consideration.

A critical examination of the precise action of salt in butter, especially in reference to its dehydration and its influence on the stability of the texture is an alluring proposition.

The increase and encouragement of nut culture in British Columbia seems to be a worthy theme for those interested in the agriculture and the food supply of the country.

The chemical composition and biological changes of animal fats as influenced by breeding and feeding our meat producing animals deserves attention.

Other food ingredients which yield little or no energy and yet indispensable to the body are the mineral salts. Numerous compounds of potassium, sodium, magnesium and iron are found in our body and in our food, and are necessary to life. These minerals and others are supplied to us in almost any diet in more than sufficient amounts for our requirements, so that the question of mineral salts is not very important.

There are a few other general problems I would present for consideration. They are briefly, as follows:—

(1) The value and rôle of yeast as an accessory to proper diet.

(2) The spoilage of food with special reference to Botulinus and Ptomaine poisoning.

(3) The utilization of straw and sawdust for feeding purposes by predigestion with chemicals.

(4) The usefulness of packing house wastes, especially connective tissues for the manufacture of glue and edible gelatin, and a study of the fundamental problems concerning the nature of these.

(5) The fibre making possibilities of native grasses of British Columbia, and a discovery of suitable solvents for the gummy materials they contain and an efficient bleaching agent for them.

I have endeavoured to place before you a few of the Research Bio-chemical problems in Agriculture, or related to Agriculture, in reference to Foods; the suggestions have come to my attention during the course of several years of analysing and examining a variety of foods and other products of the farm; this has been supplemented with an extensive exploration of the available literature.

It has been said that Agriculture has become the newest of the arts, by the grace of modern science. To make two blades of grass grow where one grew before is too easy now. Multiplying by two is small boy's play. Saunders, Wheeler, Dryden and Burbank have out-Edisoned Edison! They and other researchers in the realm of plant and animal biology have increased the efficiency of every live farmer in the land and have perhaps added a billion dollars a year to the nation's wealth.

The worker in agriculture actually produces the world's potential wealth, whereas, the workers in other industries only manipulate, control and distribute the product of the farmer's toil.

The modern agricultural researcher is progressive, he has taken his work seriously and has endeavoured to use his training for the welfare of his fellows; it is because of this fact that the modern farmer is more efficiently equipped than ever before. It enables him to cope effectively with the difficulties of nature and to put up a more confident fight with born climate, fickle weather and ever changing markets; because he knows the scientific points of the game.

The forecasts of future development which I have indulged in must be taken as purely speculative. I leave you to judge of their practibility.

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Bio-chemical Aspects of Insect Control.

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As one considers the environmental features of insect life, the relationship between insects and their hosts, one cannot help but be struck by the individual preferences so often exhibited in the choice of a plant or part of a plant, or the selection of an animal upon which to subsist. While we recognize that predaceous insects are usually general feeders and that many phytophagous insects attack many different varieties of plants, often of widely separated families, we at the same time recognize that fundamentally insects are individualistic in their choice of habitat or in their selection of a host. While on the Pacific Coast of the North American continent the cultivated apple may have close upon two hundred species of insects associated with it and the Western Yellow Pine over one hundred, habits of attack are acquired and not all are injurious or of a nature that may be considered serious. Some of the associated insects indeed may be beneficial, others neutral in their sphere of influence, and others injurious, interrelated by some chain of natural circumstances especially attuned to their environment. A major pest is one with especially selective habits which by reason of its peculiar nature of injury or its ability to reach optimum conditions of development, seriously affects the commercial cultivation or use of a crop. Even though our commonest cultivated plants and native vegetation may possess a long list of associated insects, the number

that are of major importance is limited. Wheat and corn both are attacked by a large variety of insects, many with their origin in native wild grasses, but the number of insects which seriously affect the commercial value of these crops is comparatively few.

The same applies to insects affecting animals. Kellogg has shown that 264 species of bird lice (*Mallophaga*) affect 257 species of North American birds and while it is pointed out that several species may infest a single bird it may also be seen that a single species is often restricted to a single species of bird. What occurred during the earlier years one cannot state with any degree of certainty Evolution which doubtless has played its part in the development of structure has also doubtless been of importance in the development of habit. It would not be unreasonable to assume that originally host plants and host animals have followed definite lines of development in association with definite forms of parasitic or phytophagous insect life, and that the closeness of related genera might be proved by the affinity of certain parasitic insects. Ferris in California, writing in the Journal of Mammalogy, Vol. 3, 1922, draws attention to the fact that where a certain species of louse occurs on certain species of seals (*Phoca*) whose habitat is in the Atlantic and Pacific Oceans respectively, it might be shown that the animals have a common origin, having sprung from the same stock. Likewise he has pointed out that there is upon the llama of South America a very peculiar louse that appears identical with one originally described from the camel. Furthermore it is claimed that the lice of the monkey find their nearest relations in the lice of man. We know today that sheep possess certain parasites peculiar to themselves; horses, cattle and humans likewise. It is possible in the future we may be able by cataloguing the various external and internal parasites, including the bacterial diseases, to develop a line of ancestry which will support or contest evolutionary theories based on structures.

Life is today so complex that a great deal of study is necessary to segregate and arrange items in logical order; the interrelations of insects, plants, and animals have gone so far on their way that it is difficult now to pick out the interlacing threads. And yet if we possessed knowledge which at least would indicate possible lines of development we might conceivably within the short space of a man's life and within his limited perspective, point out evolutionary habits in the making. A "biological species" is a familiar term to entomologists. It implies that two insects, each with separate food plants, apparently with no connection one with the other may be structurally similar to all intents and purposes. The illustration that comes to mind at once in this connection is the Apple Maggot, (*Rhagoletis pomonella*) an important apple-infesting insect in Eastern Canada. This insect occurs in great numbers in Western Canada, associated with Snowberries (*Symphoricarpus*) but not connected so far as we have been able to determine with apples. It is possible that this insect originally infested native berries before apples were grown commercially or in improved strains, and that, gradually, by force of circumstances, by chemotropic reactions, certain individuals crossed over to the apple until an apple strain was bred which continued apple infesting for succeeding generations. It is interesting to note that sweet and subacid apple varieties are preferred by these flies.

One cannot be too bold in assertion but one may be excused in supposition. *Hypoderma bovis*, the Cattle Warble Fly, is primarily a cattle infesting species. From its life history and habits it is evident that it has for a long time been associated with cattle. The Bot Fly (*Oestrus ovis*) is associated with sheep. It is possible that originally the two types of flies arose from a common ancestor, each associated with its respective groups of animals, evolving through the years to the types we know today. The process of evolutionary development doubtless is still continuing. From the reports that come from the cattle country of the West that horses are now becoming infested with *Hypoderma* larvae it is permissable to surmise that this is an evolutionary habit in the making. Larvae which structurally appear to belong to *Hypoderma bovis* are found on the backs of horses, but thus far the adults have not been reared. Without extending the hypothesis which the habit of this cattle insect or the reported difficulty in rearing brings to our mind,

for fear of false interpretation, with lack of evidence, it is more important to consider the common remark of the cattle country "that only one or two horses in a band are troubled with warbles." There seems to be a clear impression that certain horses are especially selected by the flies for oviposition each year and that some horses are totally immune. Certain human beings, we know, are more troubled with the "bites" of mosquitoes or the "stings" of wasps than others. A certain immunity may, of course, be built up as a result of long association but immunity does not necessarily imply lack of attack, it signifies a lower degree of after results. Inasmuch as the majority of horses in the North-west are not attacked by warbles it may be assumed that a long standing degree of immunity does not exist. Gadding so common among cattle is not reported among horses so far as our experience goes. Hence the isolated attack on a horse may be an evolutionary process and an analogy might be drawn to the instance of the *Symphoricorpus* apple-frequenting fruitfly. This is possibly drawing a bow at random but if time permitted many examples could be given, sufficient at least upon which to base an hypothesis.

Natural phenomena are selective. Natural forces are guided by specific rules free from the supernatural conception of purpose. Lightning, during a thunder shower has been known to strike a specific horse in a barn and to kill it. This action is not metaphysical in suggestion but quantitative in that the animal struck doubtless was in a condition which attracted the shaft of lightning, and the natural phenomena present can be duly measured and registered. Insects likewise, in a metaphorical sense, are comparable to the shaft of lightning in that certain guiding rules serve them in the choice of, and in directing them to, their food plants or hosts. In the elementary analysis insects are attracted to their hosts not as a result of the theories of vitalism but for the reason that their perspective senses are attuned to the conditions they find suitable for development. It is these conditions the writer would like to examine briefly as a premise on the biochemical aspects of the control of injurious insects.

In an article in the Agricultural Gazette of Canada, October 1917 on the "Natural Resistance of Plants to Insect Attack", the writer stated that "among the various natural means of controlling injurious insects of economic importance, in the field and orchard, that method which incorporates the essential features of a certain degree of "varietal immunity" or "varied resistance" may be included. Conditions of immunity or resistance may be applied to certain species of plants or hosts, or certain individuals within a species, which possess a peculiar degree of resistance complete or partial, as the case may be, which enables them to withstand attack better than others". In this article the writer endeavored to show that in addition to the physical aspects of good soil, vigorous growth, meteorological factors and climate there were some natural laws at work which permitted hosts to be either entirely immune from attack by insects or only partially susceptible. No effort was made at this time to determine what these natural laws were but a suggestion was offered that by observation and field trial, from an empirical point of view, some alleviation in the degree of attack by an injurious species might be obtained. Not a great deal of further information on underlying reasons may now be offered but at least a further suggestion may serve as a basis for study.

Life, according to Herbert Spencer, in its broadest and most complete definition is "the continuous adjustment of internal relations to external relations." Loeb dealing with animal conduct states that the "voluntary and instinctive actions of animals are determined by internal or external forces." Folsom in drawing attention to the responses of protoplasm to stimuli which are as "inevitable as the response of a needle to a magnet", records that "environmental influences may control the direction of locomotion of an organism." These reactions are known as Tropic reactions. Many tropisms are said to exist, the ones which appear to pertain to the subject of insect pests of animals and plants, are briefly:—Chemotropism, Stereotropism, Geotropism, Phototropism, Heliotropism and Thermotropism Wheeler considers the most important factor in the lives of insects is Chemotropism, where the organs of taste or smell are acted upon by stimuli which affect muscular tissue.

Insects, as we all know. are structurally bilaterally symmetrical, not only as regards general external structure but also in the number and location of sensory organs and muscles. In the presence of an external stimulus, internal reactions are equalized and symmetrical movements take place, which are unavoidable.

Verschaffelt (Proc: Sci; K. Akad, Wet, xiii, 1910) in drawing attention to the relationship of the Cabbage White Butterfly and its larvae to the plants of the cruciferous family also noted that Reseda and Tropaeolum were selected. Analysis showed that certain glucosides, the mustard oils, were present and that sinigrin, the glucose agent in black mustard was the attractive agent. Diverse leaves of other botanical families smeared with this substance were devoured by *Pieris* larvae when otherwise they would have been refused. Chemotropism to the mustard oils was therefore present and evidence was obtained to show why the cabbage white butterfly chose plants of the cabbage and mustard family in preference to apples, potatoes or melons. We obtain the same point of view when our bread is spread with marmalade or axle grease. Our thanks are due to Imms of Manchester University and to Hewitt, late Dominion Entomologist for Canada, for drawing attention to the great need for further research into the forces, mainly chemotropic in nature, which attract specific insects to specific substances, plants or animals. Imms and Husain (Ann. App. Biol:6: 1920) have summarized certain features in this connection which will bear repetition. A few reactions are recorded for illustration as follows:—

The Vinegar or Pomac Fly, *Drosophila ampelophila*, which normally frequent fermenting fruits may be attracted by mixtures of Ethyl-alcohol 20% and acetic acid 5% (Burrows).

The sawfly, *Priophorus padi*, is attracted to the Rosaceae owing to the presence of amygdaline. (Verschaffelt).

Sarcophagid flies are drawn to skatol, a substance present in faeces. The stable fly, *Stomoxyx calcitrans*, will oviposit in substances saturated with valerianic acid, a substance found in decaying vegetables. (Howlett).

The House Fly, *Musca domestica* was found to be strongly attracted to ammonium carbonate, a chemical present in manure. (Richardson).

Many other illustrations of a strictly chemotropic nature might be cited which clearly advance reasons for the affinity of insects to their hosts. Our knowledge has not advanced far enough to take care of more than a comparatively few instances and it is in this connection that much study is needed.

It should be sufficiently clear, however, that a good case may be presented to show that the relation of insects to their food plants, animals or substances, is a form of orientation, free of the anthropomorphic point of view.

If this is granted we may with equal justification state that insects refrain from attacking certain plants by reason of the presence of certain substances which are distasteful to them.

There is much to be learnt about the sensory reactions of insects. These organs are usually considered associated with the antennae and palpi. Attention is drawn to the remarkable development of the antennae in certain male moths, and many references may be seen to the great distances certain male moths are drawn to the females of their species. Sensory pits, areas, rings or cones may be actually seen and studied, histologically, in many insects. There is little doubt that sense perceptions may be obtained through other organs than those now popularly believed to be active. Minnich (Tr. Exp. Zool: 35-1922) found the tarsi of the Red Admiral Butterfly to be chemoreceptors. There is much to be learnt about radiography, telepathy, thought transference, hormones and many kindred phenomena. Our knowledge on these matters is only now in its infancy and there is little doubt that the field of speculation and surmise will be greatly enriched by researches of a very intimate nature in later years.

On the whole our knowledge is woefully lacking in understanding of the fundamental reasons why insects attack or do not attack certain plants and animals. Our familiar friend the Tent Caterpillar (*Malacosoma pluvialis*) of the Pacific Coast at first glance appears to be omnivorous but we know that the evergreen, cascara, dogwood, vinemaple and pear are avoided even

in years of extreme prevalence. *Rhus toxicodendron*, the Poison Ivy, is immune to the attacks of all but a few insects; the common garden lettuce has few enemies, peppers, laurels, ivy likewise and so on. With a little thought on the subject many examples might be given. It is this thought in speculative biology the writer would like to advance as a basis for consideration. It might be possible that as a result of the separation of the essential oils or extracts of plants to prepare liquid sprays or medicated powders which would act negatively chemitropically on our so called insect pests. It is being done with tobacco, pyrethrum, hellebore, derris and certain other substances and there is no reason why the future should not develop methods of combatting insects along physiological lines.

The various tropisms mentioned earlier in this paper are as already stated of lesser importance than chemotropism in serving as original forms of attractants. They all doubtless play their parts in determining habits.

There seems little doubt that, in general, insects are attracted to their food plants, hosts or habitat by positive chemical stimuli, and repelled by negative chemical stimuli and that their actions in their habitat are governed by a complex set of stimuli which while they can be expressed are not fully understood. It is our problem to study in order to know, to experiment in order to determine these facts which may in the end prove of immense value and may result in further measures to be added to our already known methods of pest control. We have made immense strides in recent years in the use of arsenicals and caustic washes. The various studies on how insecticides destroy insects have opened up wide fields of conjecture and while we do not doubt for a moment that our present measures are in the main as effective and economical as we are able to devise, nevertheless we acknowledge that we have not properly considered the reactions of these substances upon the sensory organs of insects and it is this field that awaits study.

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Breeding Problems as Related to Animal Husbandry.

BY W. H. HICKS

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The study of Animal Husbandry is one of the most interesting and pleasant studies on the programme of any Agricultural College or University, and one of the greatest character builders. Something called heredity or instinct found in animals is indescribable; it is difficult to define and yet means so much. You have all seen the mutual understanding that exists between a *good* teamster and his team, the confidence a champion calf displays in his happy young master, or the concern exhibited by the watchful Collie, when the infant left in his charge shows signs of distress. These feelings are pleasures which the study of plant life does not produce and only human affection can surpass.

The animal breeder, besides working with superior beings, has certain other advantages over the plant breeder. Both male and female parents are known and carefully selected and there is less effect from climatic conditions or environment. Really good breeding animals are worth a large sum of money in view of the fact that they are not so readily or quickly multiplied.

The plant breeder on the contrary has an advantage over the animal breeder in that he can handle a relatively larger number of individuals. In animal breeding scarcity of material is a drawback. The fact that the animal breeder has to select his stock with a number of objects in view makes it a difficult task. Domestic animals multiply slowly, particularly horses and cattle. Some time must elapse before they reach maturity, which is the only proper time for selection,

and then they may not have been correctly developed. The fertility problem is greater in animal breeding than in plant breeding. Domestic animals do not reproduce asexually while many plants do and others are propagated by grafts or cuttings. Individual animals are costly, especially those of high breeding powers and hence animal breeding is an expensive proposition.

There are a number of breeding laws known to the amateur breeder and many others known to the breeder with more experience. The law of variation, working in opposition to the law that like begets like, opens up a large field of problems for the live stock breeder. If the law that like begets like were true in every sense, there could be no improvement. Horses reproduce as horses, Clydesdales reproduce as Clydesdales. but large horses do not always reproduce as large horses. This morphological variation which relates to difference in form or size may be due to heredity, environment, or lack of development. Variation allows the selection of the desirable characters and improvement will probably result from further selection. Variation is the only basis for advancement, and yet what disappointments the breeder gets from the law of variation! He may mate a fast mare with a fast horse and get something useless or a fast mare with a slower horse and get something speedier than either. Functional variation is indeed quite common and relates to deviations in the normal activities of the various organs and parts of the body.

There are certain standard problems that are generally recognized by breeders of many of the most popular breeds of live stock, or if you please to call them such, common criticisms of the different breeds. In this class we find, lack of size in Clydesdale horses, poor legs in Percherons, small percentage of butterfat in milk from Holsteins, absence of ability to mature sufficiently early in Yorkshires, small litters in Berkshires, and many other such problems. Some breeders, recognizing the shortcomings of their breed, have undertaken by breeding and selection to eliminate its fault, and with some degree of success, but in many respects the Holstein breeder for instance, who has aimed only to increase the test of his herd, has done so at the expense of other more desirable qualities. Improvement can only be carried on in one direction to a certain limit with safety because, as mentioned earlier there are so many other characters to breed for in animals. Great strides may be made in increasing the butterfat content of milk at the expense of quantity, or lack of constitution, or recognized type in the animals. In our Holstein herd at Agassiz we have a good example of Substantive Variation. One of the poorest testers in the herd has two full sisters that are excellent testers. The dam is also a good tester and the sire left many daughters above reproach in this respect. Families and individuals vary in the ability to produce milk with a good fat content. There is apparently plenty of room for research work along the line of ability to fix the percentage of fat in milk.

In connection with type in live stock the breeder is always facing the problem of fashion. Fashion decides the shape of the horn, the colour of the animal or the length of its face. Fashion often forgets utility and creates a fad which may be either useful or harmful to the breed. If the new fashion emanates from the market demand for the stock it must be catered to. If it is only the act of some breeder to get a sale for his stock, no attention should be paid to it. The breeder must decide if this demand is permanent or temporary and if the latter, he must get a sire with pronounced type in this respect for use in his herd. The best breeding females should be kept free from contamination with the fad. The breed associations can do a great deal towards directing fashions, by advising members and selecting judges at Exhibitions.

One of the greatest problems the livestock breeder has to face is the sire problem. A good herd will soon deteriorate unless good sires are used. The owner must always be on the look out for a herd sire. When we consider the variability in breeding and the fact that some of the most mediocre looking animals are often the best breeders, and many of the prize winners on type models are the poorest, we realize the importance of testing sires. It is much more important to have a tested sire than tested dams, as fifty per cent of the offspring is sire. The only satisfactory way to test a young sire is on the older tested dams in the herd. Their breeding powers and peculiarities are known

and a fairly accurate knowledge of a sire's breeding power may be arrived at when his offspring from tested dams is matured.

Next to the sire problem is the problem of line or inbreeding. How closely can breeding be done with safety is a question frequently asked. Many herds have two sires and the females are bred to their grandsires or in many instances to their sire. How long can close inbreeding or line breeding be carried on without the strain or family "running out", or how often is it advisable to make an out-cross, are questions the breeders frequently discuss. If close line breeding could be carried on and its advantages secured without encountering its dangers a great amount of good would be accomplished.

We frequently read statements to the effect that milk producing qualities are inherited from the dam's side rather than the sire's side. Definite information on this point would be valuable but, like many other characters, it appears to vary under different circumstances. What is the real influence of sire and dam and which does the offspring resemble most?. If the dam breeds after herself and is a good animal, she is valuable. If she breeds after herself and is a poor animal, she is valueless. On the other hand if she produces offspring more like the sire she is valuable but care should be taken to use only the best sires. Following right along the same line of thought comes the question of the influence of the environment, care or feed of the pregnant dam on the offspring. If the offspring is larger at maturity than the dam, how much is due to inheritance and how much to environment?

The problem of sex control is a vital one to the live stock breeder. By some plan nature controls the sex, and in spite of the fact that some so called breeders declare they can control sex, there is at the present time no method known. The person who finds the secret of this scheme of nature can give to the live stock breeder a great gift. Certain sires have left a large percentage of daughters, others a large number of sons, yet nature in some unknown way controls and apparently produces approximately an equal number of each sex.

One other problem indirectly falling within the scope of an article of this kind but which so vitally affects the bank account of breeders that some reference must be made to it, is that of abortion disease. The fact that a group of livestock men, prominent breeders in this Province. some time ago interviewed the head of the Federal Department of Agriculture regarding what might be done in the way of investigational or research work in studying contagious abortion, is proof that they realize the importance of this work. At the present time authorities diasagree in regard to the proper control, and as the loss is very great, particularly in dairy herds, no research work would be more welcome.

It would not be well to conclude without mentioning the feeding and marketing problems of the animal breeder. There are continually new feeds being placed on the market while the prices on the present feeds are always changing. The breeder must keep in touch with these conditions so that he may produce his live stock as economically as possible. The real test of the private breeder after all is measured in profit. If he produces excellent stock his success is assured. With markets as they are at the present time the resources of the best breeders are taxed to the utmost. The markets, however, even in the poorest times, have always room for the high class stock. and quality and cooperation sound the keynote of success.

With regard to what research work should be done in this Province, a few questions have been mentioned that some animal breeder might answer. In view of the fact, as mentioned before, that live stock breeding is an expensive business when carried on experimentally, one hesitates to describe a fully equipped animal breeding research station, where animals of all types and breeds are housed, a first class laboratory with full equipment in connection, and a full staff of experts in charge working toward the solutions of live stock problems.

Nos Connaissances Actuelles sur le Lait

PAR M. LOUIS BOURGOIN.
Ecole Polytechnique, Montréal

(Suite du numéro d'Octobre)

Les accidents de diarrhés infantile attribuables au lait pasteurisé en été sont en définitive, bien plus mortels que ceux dus à l'ingestion de laits renfermant quelques bacilles tuberculeux boivins dont la prolifération est nulle dans le lait. Nous savons maintenant que la pasteurisation a pour principal effet de détruire les ferments lacliques (ceux j'appelle comparativement aux autres les bons mircobes) et de laisser indemne les bactéries protéolytiques. Ces dernières sont ordinairement saprophytes mais elles peuvent devenir très dangeureuses par leur nombre et les toxines qu'elles sécrètent qui, élaborées avec les matières protéïques surtout, sont bien plus novices que l'inoffensif acide lactique produit de transformation du lactose par les ferments lactiques. Or, les bactéries protéolytiques ne se développent pas en milieu aide, comme d'ailleurs presque toutes les bactéries pathogènes. Leur multiplication n'est possible dans le lait cru que quand les bacilles lactiques ont terminé leur travail et que l'acide formé est disparu. Les laits pasteurisés s'acidifient lentement ou pas du tout; les bactéries protéolytiques, à la faveur des températures de l'été, se développent rapidement dans le lait pasteurisé puisque la concurrence vitale avec les ferments lactiques est presque annulée. Dans les laits crus, l'acidité peut être considérée comme un bon indice de l'âge du lait, il n'en est pas de même avec les laits pasteurisés qui se conservent bien plus longtemps sans s'acidifier, ils peuvent *vieillir* sans qu'on s'en aperçoive au goût, c'est en cela qu'ils sont dangereux en été particulièrement quand ils ne sont consommés que 18 à 24 heures après la pasteurisation. (24)

(24) Dans les conclusions de son article sur les Avantages et inconvénients de la stérilisation du lait par la chaleur le Dr. Schreiber de l'Institut de Puericulture de la maternité de Paris, demande même que les laits pasteurisé portent mention sur une étiquette de la nécessité de les faire bouillir.

Dr. H. de Rotlischild: *Le lait* Paris 1903.

A.-B. Marfan: (loc. cit.)

Dr. G. Schreiber: *Avantages et inconvenients des divers procedes de sterilisation du lait par la chaleur. Le monde Medical,* No. 58° fevrier 1921. *Très complet.*

Enfin je me range humblement derrière des autorités comme le professeur Marfan qui dans son récent "Traité de l'allaitement" fait le procès complet de la pasteurisation du lait, ne recommandant pour l'alimentation des jeunes que le lait stérilisé ou bouilli. Donc au point de vue industriel, la pasteurisation du lait précédée et suivie d'une conservation constate à basse température est recommandable pour l'expédition et la distribution dans les grands centres, au point de vue de l'hygiène, hygiène infantile surtout, il faut mettre le public en garde contre les défectuosités du lait pasteurisé.

Les dernières découverets qui ont jeté un jour nouveau sur la science alimentaire me font croire qu'un retour aux aliments naturels est souhaitable. Il doit bien encore y avoir des inconnues; et avant de modifier les produits que la nature nous donne, je trouve préférable de tolérer les quelques bactéries pathogènes que le lait peut contenir plutôt que d'amoindrir les qualites des éléments qui confèrent à notre organisation une bonne résistance. Il ne nous est pas possible de nous garer avec certitude contre l'atteinte des germes pathogènes qui nous entourent; renforçons notre corps par des mesures d'hygiène bien comprise, assurons nous une bonne et complète nutrition, c'est peut être le moyen le plus sûr d'éviter les maladies.

Ebullition—Il existe un procédé intermédiaire entre la stérilisation et la pasteurisation qui permet la destruction des espèces de bactéries pathogènes sans altérer beaucoup la constitution du lait; c'est l'ébullition. Ce procédé simple est pour moi le seul recommandable dans la pratique de l'hygiène infantile, quand on veut, sans recourir au lait stérilisé, donner à l'enfant un lait certainement privé de germes dangereux.

L'ébullition durant cinq minutes n'altère pas plus le lait que la pasteurisation, en enlevant la peau (frangipane) on rêduit quelque peu la teneur trop grande du lait de vache en caséine et on enlève aussi les microbes qui auraient résité à la chaleur. La pellicule se forme vers 75-80°C (167-176F)

le lait monte à 85-90° (185-194F) il bout à 101°C (213F).

Si on a soin d'assurer la propreté des transvasements ultérieurs à l'ébullition, l'ébullition est le procédé de choix dans toutes les familles pour l'alimentation des enfants en bas âge dans les villes et même dans beaucoup de campagnes. La digestibilité du lait est augmentée par l'ébullition qui fournit de plus l'indication d'une altération si le liquide ne la supporte pas.

Evaporation—(25) Tous les procédés que nous venons de voir, sauf la stérilisation encore avec certaines réserves, ne peuvent assurer au lait une conservation bien longue. On a donc été amené à employer d'autres moyens. Sachant que les bactéries ne peuvent se développer dans les milieux très sucrés ou pauvres en eau, on a pratiqué l'évaporation d'une partie des 87% d'eau du lait pour avoir des laits concentrés ou condensés et, pour une autre catégorie en ajoutant du sucre de canne, des laits concentrés sucrés.

Les laits concentrés non sucrés sont obtenus par simple évaporation généralement sous le vide de laits ordinaires ou écrémés. L'abaissement du point d'ébullition par le vide assure un peu la conservation d'une partie des propriétés du lait ordinaire; mais pour que ce lait sans sucre puisse se conserver longtemps on doit le stériliser, on retrouve alors les inconvénients du lait stérilisé.

Les laits concentrés sucrés sont plus répandus et leur emploi dans différentes industries plutot que dans l'alimentation proprement dite va croissant. Ces laits sucrés, puis évaporés jusqu'à ne plus contenir qu'environ 24 à 30% d'eau doivent se préparer avec des laits essentiellement frais, entiers ou fortement écrémés. Il suffit de les additionner du volume d'eau indiqué par le fabriquant pour obtenir un lait reconstitué.

Nous nous trouvons en présence d'aliments ayant subi des traitements industriels, nul doute, que les liquides obtenus au moment de la consommation soient loin du produit naturel si fragile que nous donne la vache. De telles préparations peuvent rendre de réels services dans des cas très spéciaux d'alimentation des enfants (bateaux, régions éloignées), il ne serait pas prudent d'en recommander un emploi exclusif. Il en est tout autrement dans l'alimentation de l'adulte chez qui un régime varié apporte up peu de tous sous les formes souhaitables pour assurer une bonne nutrition.

Dessication.—Voulant pousser plus loin la possibilité de conservation du lait, on en est venu à le priver pratiquement de toute l'eau qu'il contient pour ne lui laisser qu'un minimum sans importance de 2 à 8%. Je ne pas à m'étendre sur les procédés industriels qui permettent de débarasser le lait de la majeure partie de son eau. La poudre de lait s'obtient avec des laits entiers, quoique cette dernière s'altère assez rapidement et avec des laits à demi ou totalement écrémés. Il faut toujours opérer sur des laits strictement frais pour obtenir des produits réussis. La reconstitution du lait se fait par simple dissolution de la poudre dans l'eau tiède qu'on peut avoir fait bouillir pour la stériliser puisque la poudre est pauvre en bactéries et qu'il est toujours bon de conserver cette propriété. Si on ajoute à ce liquide de la crème, du beurre et qu'on passe le tout dans un homogénéïsateur, on a le lait reconstitué qui au moins sera riche en vitamines solubles dans les graisses apportées par le beurre.

La poudre de lait n'est que rarement employée dans l'alimentation de l'enfance, pour la cuisine et la pâtisserie elle est de plus avantageuses. Beaucoup de médécins qui à son apparition étaient opposés à son usage changent aujourd'hui d'opinion après s'en être servis avec satisfaction pour des cas déterminés.(26).

(25) O.-F. Hunziker: *Condensed milk and Milk Powder* (1918). A. Rolet: *Les industries annexes de la laiterie,* Paris 1920.

(26) Laits concentrés.

	Evaporé Lait entier	Concentré sucré Entier	Concentré sucré Ecrémé
Eau	74.28	26.61	28.94
Extrait sec	25.72	33.47	
Sucre canné	0.	39.92	39.49
Lactose	8.94	13.58	13.09
Protéines	6.93	8.70	12.71
Graisses	8.26	9.53	2.63
Cendres	1.39	1.91	2.24
Poudres de lait			
Mat. sèches	96.14		95.56
Mat. grasses	28.30		15.80
Lactose	32.96		41.64
Azote total	4.40		4.75
Nx 6.557			
Mat. albuminoides	28.85		31.15
Cendres	5.68		6.54

Nous pouvons répéter ce que nous avons déjà dit: Rien ne vaut le lait cru proprement récolté et conservé par le froid. Seulement nous ne sommes pas de ceux qui condamnent les produits industriels sans tenir compte de leur valeur: les laits concentrés et évaporés répondent à un besoin. Ils permettent une certaine régularisation dans l'utilisation des produits laitiers. Ils assureront, quand on voudra bien en faire un emploi judicieux, la provision de bon lait dont ont besoin et les bébés et les malades dans les périodes difficiles de l'hiver où le lait est rare dans les grandes villes canadiennes.(27)

Antiseptiques—Si je mentionne la conservation du lait par les antiseptiques c'est surtout parce que je crois qu'il en est un actuellement qui mérite une mention. C'est l'eau oxygénée (peroxyde). L'eau oxygénée n'est pas un poison, elle a des propriétés bactéricides marquées et cela à très faible dose (1 à 2%) Elle disparait dans le lait au bout d'un certain temps, la catalase met en liberté l'oxygène et l'eau. C'est grâce à cet oxygène à "l'état naissant" que l'eau oxygénée est fortement bactéricide, laissé au contact du lait elle accomplit son oeuvre qu'un léger chauffage active en assurant la disparition complète du produit initial. C'est surtout en Allemagne qu'on a voulu généraliser son emploi pour la conservation du lait.

Il répugne à tous les hygiènistes cependant de permettre l'adjonction d'une substance quelconque dans le lait; en fait ils ont raison à cause des abus possibles, mais je ne vois pas de différence au fond, entre défendre un traitement chimique inoffensif et ordonner des traitements physiques, qui ne respectent pas du tout les éléments du produit naturel.(28).

(27) G. C. Supplée: *L'importance au point de vue nutritif des laits liquides et desséchés: Le Lait*, No. 7, 1921

(28) En 1909 le Conseil supérieur d'Hygiene publique de France a admis l'emploi de l'eau oxygéné dans le lait sous certaines conditions: 2 hcc par litre absolument pure exempte d'arsenic; le lait sera ensuite pasteurisé et ne devra plus contenir le produit au moment de la mise en vente. Jean Mercadier: *Le Lait*, page 432 et suivantes; voir M. Fleischmann: *Antisepsie de l'oxygène ajouté au lait pasteurisé. Le Lait*, No. 4, 1921

Il y a un champ immense ouvert aux recherches, tous les jours dans l'industrie laitière nous sommes en présence de problèmes qui restent sans solution précise. On a parlé, sous l'autorité d'un maître, sur les questions du lait, le professeur Ch. Porcher, d'un Institut international du lait (29) pour étudier ce liquide à tous les points de vue. En attendant, et même si la chose aboutit, il y aura toujours avantage pour chaque pays à poursuivre des recherches sur le lait; il sera toujours possible de les coordonner. Le Canada fait-il réellement des efforts sérieux au point de vue scientifique et industriel sur les questions laitières? Ceux qui connaissent sont dans la pratique industrielle autant qu'au laboratoire sont obligés de répondre non. Il s'est fait un gros effort dans la Province de Québec, l'Ecole de Saint-Hyacinthe à laquelle il faut toujours rendre hommage, le département d'Agriculture du gouvernement fédéral a travaillé beaucoup pour l'amélioration de l'industrie laitière au Canada; mais on semble s'arrêter faute de crédits suffisants pour la recherche. Je trouve aussi une autre raison à cet arrêt. Le Canada s'est un peu grisé de certains succès obtenus par sa production laitière. On a cru qu'il n'était pas nécessaire de perfectionner tous les jours, c'est oublier qu'en industrie, ne pas avancer est un recul qui devient vite une faiblesse.

Que de questions pourtant attendent les études préliminaires que seule une institution scientifique peut entreprendre:

L'amélioration des races laitières et l'alimentation, la tuberculose bovine et les microbes du lait.—Combien d'incertitudes dans la fabrication du beurre! que de qualités de fromages à implanter au pays pour créer des industries agricoles qui manquent! Que de recherches sur l'utilisation des sous-produits que nous perdons chaque jour, sur la fabrication des aliments de première valeur comme la crème glacée! sur les vitamines, sur les diastases et la coagulation du lait. Nous attendons que notre grand voisin nous importe les solutions toutes faites: c'est plus commode et apparemment relève moins cher.

(29) Ch. Porcher: *Revue Scientifique* 1920 sur *La création d'un Institut de lait. Le lait*, No. 1, 1921 page 812.

The 1000-Kernel Weight of Seed in Relation to Experimental Error.

BY M. O. MALTE.

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A lecture delivered at the C. S. T. A. Convention, June, 1922.

(Concluded from last issue)

Relation Between 1000-Kernel Weight and Amount of Seed Sown in Variety Tests.

In order to demonstrate what influence the 1000-kernel weight may have on the correctness of the results from variety tests, a table is herewith submitted which has been taken from the Journal of the Swedish Seed Association, Svalof, Sweden, (Vol. 25, p. 37), and which has been somewhat elaborated.

Table 4.—Variety test with timothy.

No.	Per Cent Germination	Per Cent Purity Weight	1000-Kernel Per Gram	No. of Kernels Sown	Amount of Sown
1	98.5	100	.57	1755	13.6
2	97.5	100	.50	1960	12.9
3	99.0	100	.60	1665	13.5
4	98.0	100	.59	1695	13.5
5	98.0	99.2	.44	2270	10.9
6	99.5	100	.67	1495	15.0
7	98.5	99.7	.46	2175	10.5
8	98.5	92.7	.53	1885	13.0
9	99.5	100	.60	1665	13.5
10	98.7	100	.56	1785	12.5
11	94.0	100	.65	1540	15.5
12	99.0	100	.52	1925	11.5
13	99.0	100	.35	2860	8.0
14	98.5	100	.52	1925	12.0
15	98.5	100	.53	1885	12.0
16	98.5	100	.47	2130	10.5
17	99.5	100	.42	2385	11.0
18	97.5	100	.47	2130	11.0
19	95.0	100	.65	1540	15.0
20	99.5	96.6	.49	2040	11.5
21	98.0	98.2	.39	2565	10.6
22	96.0	92.9	.35	2860	9.0
23	96.5	98.3	.44	2275	10.5
24	97.5	99.7	.43	2325	10.0

In the third column of the table the 1000-kernel weight is given and it will be seen at a glance that it is considerably different in the various varieties, running as low as .35 in No. 13 and No. 22 and as high as .67 in No. 6, with all kinds of intermediate weights between these two extremes. In the fourth column the number of kernels contained in 1 gram of seed of the 24 varieties is given.

It is obvious that the higher the weight of 1000 kernels or, which means the same, the heavier the individual kernels, the smaller number of them there are to the gram. Thus we find that No. 6, which has the highest 1000-kernel weight, holds the smallest number of kernels per gram, viz: about 1495, whereas No. 13 and No. 22 which have the lowest 1000-kernel weight, hold the largest number of kernels per gram, viz: about 2860. The other varieties also of course contain per gram a number of kernels which is in an inverse ratio to their 1000-kernel weight.

What this means to the experimentalist, testing these different varieties, is perfectly clear. It means that if equal weight-amounts, may they be measured in gram, or ounces, or pounds, of the 24 varieties in question are sown in plots of equal size, some plots would receive a much larger number of seeds than others. Plots of equal size sown with seed of for instance No. 6 and No. 22 would receive seed at a ratio of 1495 to 2860. That is to say that if the germination and other factors are equal, plot No. 22 would contain 2860 potential plants as against 1495 in No. 6. If every seed in the two plots germinated, No. 22 would hold almost twice as many plants as No. 6. In other words, the stand of plot No. 22 would be twice as thick as the stand of No. 6. The result of course would be that a direct comparison of the yields of the two varieties would be unfair to the variety with the thin stand, or perhaps in cases, to the variety sown thickly. At any rate, the yield-figures obtained would be very unreliable, inaccurate and most likely very misleading.

In the preceding reference has been made to the existence of extremely different varieties of *Western Rye Grass*. In some of them the 1000-kernel weight is very low, dropping to between 700 and 800 mg. In others it is

high, rising to between 2600 and 2700 mg. This means that the variety with the lowest 1000-kernel weight contains over three times as many seeds per weight-unit, say per pound, as does the variety with the highest 1000-kernel weight. If equal amounts of seed of these two extremes are sown for variety tests in plots of equal size, the chances are that, if the germination is perfect and conditions otherwise equal, the one plot may display a stand over three times as heavy as the other.

Similar examples may be mentioned for all the cereals and for a number of forage plants in which the 1000-kernel weight of different varieties has been studied, but the above are, it is thought, sufficient for the purpose of showing that, if in variety tests with cereals and other field crops no consideration is given to the 1000-kernel weight of the seed lots used, the chances are that rather embarrasing experimental errors may be introduced in the variety tests from the beginning.

To a certain extent the experimental errors resulting from sowing the same amount of seed of varieties with different 1000-kernel weight may be calculated away, so to speak, when the varieties are harvested, allowances being made for unequal stand in the varieties under tests. But such a procedure is far from satisfactory. In the first place it is likely to be guess-work of a more or less pronounced inexactness and, secondly, whenever it has to be resorted to, there is the danger that the person who is doing the calculating may be inclined to do it on the assumption that the actual yielding capacity of a variety may be calculated in proportion to the stand. But the latter is of course not always a correct method from the standpoint of the desirability of securing most accurate results. To illustrate what is meant; if in a variety test a certain plot has only a 50 per cent stand and yields a certain amount of hay or grain, it by no means follows that the yield of hay or grain would have been doubled, if the stand had been 100% instead of 50%.

Calculating the Correct Amount of Seed to Sow in Variety Tests.

Taking into consideration the fact that equal weight-amounts of related varieties do not necessarily contain the same number of seed and also bearing in mind that a more or less arbitrary correction of the yields necessitated by unequal stands is rather unsatisfactory, it is evident that, in carrying out variety tests, it is highly desirable to eliminate from the beginning as much as possible any possibilities of experimental errors resulting from unequal thickness of seeding and subsequent unequal stands.

This can be done to quite large an extent at least, if variety tests are seeded down on the principle of applying an equal number of germinable seed per square unit of land. This method has for many years been applied in Europe but its merits have so far not been sufficiently well recognized by Experimental Stations and similar institutions in this country.

The application of the principle of sowing an equal number of germinable seeds per square unit of land means that the experimentalist is endeavouring to obtain equally thick stands of the different varieties under test from the beginning. In endeavouring to do this he will naturally try to secure what is generally called a full stand of the various varieties, that is to say he will apply the thickness of seeding which under normal conditions is apt to be productive of the most satisfactory yields.

In order to calculate the correct amount of seed to sow of different varieties, with due consideration taken to the 100-kernel weight of the different varieties, it is of course first neessary to decide what should be considered a full stand, in other words how many plants it is desirable to secure per square unit of land, say per square yard or per square foot, or per square meter or per acre.

It is obvious that the number of plants which it is desirable to secure per square unit of land varies with the local conditions. In districts where the rainfall is abundant, a square unit of land is liable to be capable of supporting a larger number of plants than the same area in a district where the rainfall is normally scant, assuming of course that the fertility of the land is the same. Consequently, it is of importance, in the first place, to determine the *optimum* number of plants per square unit of land for the district in which the variety tests are to be undertaken. Furthermore, the number of plants which make up what is called a full stand may be different

for different varieties of the same species. For instance, if a full stand of a certain variety of Western Rye grass means so and so many plants per square yard, it does not necessarily follow that the same number of plants is required of other varieties of Western Rye grass. Differences in stooling may for instance require a larger number of seed per square yard of certain varieties than of others. And then again, in the case of grasses particularly, the density of the stand may have to be varied depending upon whether the crop is grown for hay or for seed.

These things are mentioned particularly for the reason that they embody possibilities for research work of a fundamental nature, the question involved being; What is to be regarded as an *optimum* stand of the various varieties of cereals and other field crops under different conditions of soil and climate? Accurate information on this point is badly needed and, when it is available, it will be of incalculable benefit to the farmers as well as to investigators of crop problems in general.

However, returning to the problem of how to calculate the correct amount of seed that should be sown in variety tests, if the 1000-kernel weight is taken into account. Table 4 may again be consulted. The 1000-kernel weight is, as previously explained, given in the third column. In the experiment, furthermore, it is assumed that to secure a full stand of timothy it is advisable to sow about 2200 germinable seeds per square meter. Assuming that the germination is perfect and that the seed is perfectly free from impurities in all the varieties, it is a simple matter to figure out how large quantities of seed, measured in gram, should be taken of the different varieties in order to obtain the required 2200 seed per square meter. If for instance 1000 kernels weigh 0.51 gram, as is the case in No. 1, 2200 kernels weight 2.2 times as much, that is to say 1.254 gram. And if, as is the case in No. 13, 1000 kernels weigh 0.35 gram, 2200 kernels weigh 2.2 times as much, or 0.7 gram. That is to say, 1,254 gram of seed of No. 1 are equivalent to 0.7 gram of seed of No. 13 in as much as they both hold 2200 kernels and consequently, when sown at the two rates indicated, are liable to produce the same number of plants per square yard. In the same manner it is easy to figure out what quantities of all the other varieties should be weighed out in order to secure equivalent amounts of seed or, which theoretically means the same, about the same thickness of stand of the various varieties.

The figures, which are given in the case of varieties No. 1 and 13, were arrived at on the assumption that both germination and purity were 100 per cent. But as it is only rarely that the latter are that high, it is always advisable to take them into consideration whenever strict accuracy is looked for, and more so, because if they are considered in this connection, it will be shown that a general formula may easily be worked out which can be applied to all kinds of variety tests with field crops, as follows:

Suppose that the amount of seed that should be sown per square meter is put down as X gram. And suppose, further, that the figures for germination, purity and 1000-kernel weight are g, p, and w. respectively, it is obvious that x gram of a seed sample having g per cent germination and p per cent purity contains $X \cdot \frac{g}{100} \cdot \frac{p}{100}$ gram germinable seed. But as the 1000-kernel weight is w gram and consequently the weight per seed $\frac{w}{1000}$ gram, it follows that in the quantity of seed mentioned there are

$$\frac{X \cdot \frac{g}{100} \cdot \frac{p}{100}}{\frac{w}{1000}}$$

number of germinable seeds

Suppose further that the number of seeds required per square meter is c, the following equation is obtained.

$$\frac{X \cdot \frac{g}{100} \cdot \frac{p}{100}}{\frac{w}{1000}} = c, \text{ which means } X = \frac{10.\ w.\ c}{g.p}$$

or

$$10 \frac{w}{g.\ p} c.$$

This is a general formula through which the weight-amount of seed of a variety,

which should be sown per square unit of land, can be easily ascertained when 1000-kernel weight, w, germination, g, purity, p, and the required number of germinable seeds per square unit, c, are known.

In the case of the timothy variety test referred to, the required number of germinable seeds per square meter is about 2200. Applying the formula to the different varieties the following equation is obtained for, for instance, No. 13;

$$X = 10 \frac{0.35}{99.100} . 2200 = \frac{77}{99} = 0.8 \text{ gr.}$$

per square meter, approximately; and for variety No. 6, the required amount of seed per square meter is:

$$X = 10 . \frac{0.67}{99.5 \ .100}, 2200 = 1.5$$

approximately.

In the test in question the size of the plots is 10 square meters, which gives 10 by 0.8 or 8 gram seed for plot No. 13 and 10 by 1.5 or 15 gram seed for plot No. 6. The amounts of seed required for the other varieties can be figured out in a similar manner. They are given in the fifth column.

CONCLUSION.

In the preceding paragraphs it has been demonstrated that various varieties within different field crops may exhibit great differences in respect to their 1000-kernel weight It has also been shown that equal weight-amounts of seed of very closely related varieties may contain a very unequal number of seed and that, as a consequence, unequal thickness of stand may be obtained in different varieties, tested together for comparative value, if equal amounts of seed are sown. In order to obtain as equal stands as possible in variety tests it is therefore necessary to take the 1000-kernel weight into consideration and to sow varying amounts of seed of different varieties, the said amounts of seed being calculated on the principle that equal numbers of germinable seed should be applied to equal square units of land.

If equal weight-amounts of seed are applied, as is very commonly done, considerable experimental errors may be introduced which may totally destroy the value of the results obtained.

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Note on Relative and Corrected Yields.

BY R. NEWTON,

Department of Field Husbandry. University of Alberta. Edmonton

The "relative yield" of a plot or row is its yield expressed as a percentage or fraction of that of the two nearest check plots or rows between which it lies. It may be expressed by the formula—

$$R = \frac{A}{C + (\frac{D}{N}) N^1}$$

Where R=relative yield
A=actual yield
C=the smaller of the two check yields.
D=Difference between the two check yields.
N=number of plot intervals between checks.
N^1=number of plot intervals from the smaller yielding check.

The purpose of this figure is to facilitate direct comparison between plots grown in different parts of a field or in different years. It assumes that the check variety reacts to soil and climatic factors in the same way as the varieties under test. It further assumes a regular gradation of soil and other conditions between checks, that is, it does not allow for sudden inequalities. These assumptions are not always justifiable, and probably constitute the principal sources of error.

The "corrected yield" is the value RC^m, where C^m is the mean of all the checks in a series. This gives a measure of comparison in terms of bushels, pounds, etc.

Where it has not been possible to replicate experimental plots a sufficient number of times, owing to lack of space or for other reasons, the above values have been found useful in a tentative study of the relative productiveness of varieties.

Concerning the C.S.T.A.

It is possible that the General Secretary may be able to visit the prairie provinces during the month of November and discuss with members a number of important matters affecting the Society. Final arrangements will be made with local secretaries, who will organize meetings.

The object of these meetings, in addition to discussing the work of the parent Society will be to maintain member-interest, to stimulate the activities of local branches and to interest eligible members in the organization.

The coming year promises to be one in which excellent progress will be made by the Society, particularly in the direction of increased membership. The reduction in the membership fee, applying to every member of one year's standing, is proving to be an inducement to a number of eligible members who, while quite in sympathy with the objects of the Society, considered the former fee too high. In making a fee reduction, the members of the Executive were of the opinion that the lower revenue from fees would be balanced by a larger number of members, and this opinion appears to be correct, although it is yet too soon to draw a definite conclusion.

In a number of directions satisfactory progress can be made only by united effort. That point has been emphasized time and time again. Every member is in a positon to give much individual assistance—by making this magazine more widely known, by sending in the names of new subscribers, by supporting our advertisers, by contributing articles, by obtaining new members, and by a number of other means which probably suggest themselves. If the members are content to take only a passive interest in their own Society they should not voice their criticisms when progress is not as rapid they think it should be. There are certain goals towards which the C. S. T. A. is aiming, but a solid organization of enthusiastic members is one of the first requisites. Up to the present time too much responsibility has been left with committees and there has been too little individual effort, or interest, or co-operation. Let us all work together and see that we reach a number of definite objectives this year.

ALBERTA BRANCH.

A well attended meeting of the above branch was held in Calgary early in July. Over one half the members in Alberta were present, as well as a number of others. The meeting was devoted mainly to a discussion of the agricultural representative system in Alberta. In this discussion the principal speakers were deputy Minister H. A. Craig, Dean E. A. Howes, W. H. Fairfield of Lethbridge and E. Ward Jones of Calgary.

The policy of the Provincial Department of Agriculture, as well as the tone of the meeting are indicated in the following resolution which was adopted:—

"That we, the members of the C. S. T. A. place ourselves on record as fully endorsing the policy of the Provincial Department of Agriculture in selecting only men of wide agricultural experience in rural districts, and that a copy of this resolution be forwarded to the Hon. George Hoadley, Minister of Agriulture for the Province."

BRITISH COLUMBIA

A meeting of the B. C. local is being held at Vancouver on October 27th. There will be an afternoon business session, followed by a dinner and evening meeting.

MACDONALD COLLEGE

The next meeting of this local is being held at Macdonald College during the early part of December. Plans are now being made so that the programme will be of a practical nature. Many of the most progressive farmers in the province will be invited to the meeting in order that they may discuss with members of the C. S. T. A. their most important problems. This appears to be an excellent arrangement and a genuine extension service which will be valuable to the farmer and to the technical worker.

WESTERN ONTARIO BRANCH.

A local meeting of this branch will be held at the O.A.C. during October. A larger meeting, to which all eligible members in the province will be invited, is also being arranged, and will be held later in the year.

APPLICATION FOR MEMBERSHIP

O. J. Robb, (Toronto '15, B.S.A.) Vineland Station, Ont.

C. Gautby (Toronto, B. S. A.) Director of Agriculture, Bagdad, Turkey in Asia.

NOTES

E. C. Stillwell (O. A. C. '19) is taking graduate work in Animal Husbandry at the Iowa State College.

W. Newton (Macdonald '14) Chief Soil and Crop Instructor in the Department of Agriculture, Victoria, is taking graduate work at the University of California.

F. F. McKenzie (British Columbia '21) is taking graduate work at the University of Missouri, Columbia, Mo.

M. A. Jull (O. A. C. '18), Head of the Poultry Department of Macdonald College, has just received his Ph. D. from the University of Wisconsin.

Norman James (o. A.C. '18) Lecturer in Dairy Husbandry at the Manitoba Agricultural College is now doing post graduate work in dairying at the Iowa State College, Ames.

L. H. Hamilton (O.A.C. '20) Animal Husbandry Department, Macdonald College, is on one year's leave of absence taking advanced training in animal nutrition at the University of Wisconsin.

J. S. Dash (Macdonald '13) who returned to Canada from the West Indies a year ago and has been with the Central Experimental Farm and the Dominion Seed Branch at Ottawa, has been appointed Professor of Agriculture and Agronomy at the at the new Agriultural College St. Augustine, Trinidad. He left Ottawa for the West Indies on September 25th.

E. A. Lods (Macdonald '12) Agronomy Department, Macdonald College, is taking one semester at Cornell University.

G. E. McIntosh, formerly in charge of fruit transportation in the Dominion Fruit Branch, has been appointed Dominion Fruit Commissioner. He succeeds C. W. Baxter, now General Manager of the Niagara Penissula Growers.

W. A. Maw, (Macdonald '20), Poultry Husbandry Department, Macdonald College is taking advanced training, for one semester, in Agriculture Economics and Poultry Husbandry at Cornell University.

M. H. Howitt, (O.A.C. '13) Horticulture Department, Macdonald College, is taking one year's advanced training at Harvard University.

The far-famed British Columbia Dogwood

Oat Production in Saskatchewan.

BY CYRIL H. GOULDEN,

Department of Field Husbandry, University of Saskatchewan, Saskatoon, Sask

Origin and History of Oats.

The exact origin of cultivated oats is rather obscure but the prevailing opinion among botanists at the present time is that they have originated from two distinct wild species, the common wild oat (*Avena fatua*) and the wild red oat (*Avena sterilis*). The latter species appears to have arisen at some early date in North Africa and later became definitely located in the Mediterranean region. A number of varieties have been developed from it which have been very successful producers in warm climates. The species *Avena sativa* which includes practically all of the varieties grown in Canada is probably derived from the common wild oat.

The present range of oats as a cultivated crop is not as great as that of wheat or barley. As a general rule it is more suited to a cooler climate than either of these two cereals. However, as indicated above, the varieties having originated from the wild red oat have been very productive in the warmer areas. One variety known as Red Rustproof is extensively grown in the southern states. The varieties belonging to the species *Avena sativa* thrive chiefly in cool climates. As a rule they mature several days earlier than the ordinary varieties of wheat and for this reason may be cultivated quite successfully in regions where the growing season is not so short as to make wheat growing very hazardous.

According to recent statistics oats now occupies first place in the world's production of cereals, by bushels. The following table gives the world's production of the four cereal crops for 1920:

Oats	3,184,016,000	bushels
Wheat	2,685,437,000	bushels
Barley	865,397,000	bushels
Rye	445,449,000	bushels

Canada produces about ten percent of the world's oat crop. The United States and the Russian Empire each produce about twenty-five percent. Of the Canadian crop, over one-third is produced in Saskatchewan.

Uses of the Crop.

For Grain—The oat crop has been aptly termed "the cereal of the park belt". For in that section of the province to the north and northeast of the great wheat growing region where the rolling prairies are dotted with clumps of trees, the oat crop is undoubtedly the leading cereal, and the quality of grain produced cannot be equalled on the North American continent. In these parts the climate appears to be admirably suited to oat production, the seasons being rather short for wheat, fairly cool during the spring and fall months, and with a fair amount of precipitation.

The oat crop however is not confined to the park belt region. It is grown to some extent chiefly as a second crop after fallow, throughout the entire province, the reason being that as a concentrate for feeding horses the grain is unexcelled and is very valuable as a feed for other stock. The hulls of the oats, although they reduce the actual feeding value of the grain, are a decided aid to digestion, as they keep the mass of chewed food in the stomach of the animals, more open and more easily attacked by the digestive juices.

As mentioned above, oats is the leading grain crop in the park belt and is second only to wheat in other parts of the province. It may be used however in other ways than as a straight grain crop.

Oats in Rows:—Oats grown in rows and cultivated may be utilized as a partial substitute for the summer fallow. In an experiment conducted by the Field Husbandry Department in 1921, oats sown in triple rows 30 inches apart yielded 63.9 bushels per acre, comparing very favorably with the yield of oats on fallow, 83.5 bushels per acre. Oats sown in

double rows 36 inches apart yielded 59.6 bushels per acre. The double rows are easier to cultivate than the triple rows and they leave the land in a condition more similar to the fallow. On the other hand in the case of severe storms the double rows are very easily blown over by the wind. For this reason it appears that the triple rows will be preferred by most farmers. The yields reported above are very satisfactory and it is of interest to note that, at the time of writing, the wheat crop on the land having grown oats in rows the previous year, shows every indication of giving as high a yield as that sown on fallow ground.

Oats have one advantage over the other grains for sowing in rows, namely, that they can be cut for green sheaf feed instead of for grain. Thus, should cultivation delay the time of ripening excessively, or if it has been impossible to sow them early enough to give them time to reach maturity, they may be cut green and utilized very economically as winter feed for stock.

As an Annual Hay Crop:—A number of annual hay crops have been tried out by the Field Husbandry Department, including Sudan grass, millet, winter rye, barley, and oats. From the results of these trials to date it apears that the oat crop is superior to the others in both yield and quality of hay produced. Fortunately the same varieties that have given outstanding results as grain crops are equally good for hay. This makes the problem of securing seed a simple one. The normal rate of seeding, two bushels per acre, may be increased where rich, heavy, or poorly drained land is used. A finer quality of hay is likely to result. For the drier lands a somewhat lower rate will give the best results. When used as a feed for cattle the oats should be cut when fully developed but quite green. For horses they should be allowed to attain greater maturity, the best time to cut being indicated by the tips of the heads turning yellow.

In Mixtures for Annual Pastures—One of the best combinations for this purpose is winter rye and oats sown in the spring at the rate of about one bushel of each per acre. If this combination is not too closely pastured the rye will winter over under favourable conditions and may be pastured again in the spring.

An excellent pasture mixture for spring seeding consists of a bushel of oats, a bushel of hulless barley, and a half bushel of peas, per acre. If no barley seed is available the quantity of oats may be doubled.

Oats alone, seeded at the rate of two bushels per acre, make a fairly good pasture but a somewhat heavier pasture can be obtained by broadcasting from two to four pounds of rape seed per acre shortly after drilling the oats. The rape should not be used if the pasture is for dairy cattle as it usually taints the milk.

As a Nurse Crop for Grasses and Clovers:—In sowing grasses and clovers it has been found very convenient to use some kind of nurse crop. When these crops are sown in rows for seed production the nurse crop marks out the rows early in the spring and enables the grower to begin cultivating before the weeds become well established. In all cases the nurse crop protects the young and tender plants from high winds and the stubble remaining in the fall assists in the prevention of soil drifting.

As nurse crops there is probably very little difference between wheat, oats and barley, as far as the following yields of forage crops are concerned, but oats have one advantage in that they must be removed early for sheaf feed, thus enabling the forage crop to make a fair growth before winter sets in.

Variety of Oats.

Oat variety tests have been conducted by the Field Husbandry Department since 1911. The yields per acre by years together with comparable averages are given in Table 1, for all those classed as standard varieties. Numerous others have been tested in smaller plots, the best of these being advanced to the standard variety test plots from time to time.

It will be observed that Banner, Sask. 99, is, on the average, the highest yielding variety of those which have been tested for a long period of time. In a four year period, 1917 to 1920, inclusive, the average yield of Gerlach, Sask. 104 was about four bushels higher than that of Banner. During the first three years of this test, however, the Gerlach oats

TABLE I. SUMMARY OF YIELDS OF THE STANDARD VARIETIES OF OATS IN BUSHELS PER ACRE. 1911 TO 1922 INCLUSIVE.

Varieties.	Sask. No.	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	Averages. 1911 to 1922	1917 to 1922	1917 to 1920	1911 to 1920
Banner	99	93.9	97.8	106.4	48.4	66.3	88.8	35.5	60.2	39.1	17.2	83.6	58.0	66.3	48.9	38.0	65.4
Victory	110	92.1	102.5	107.3	39.0	55.9	85.0	36.5	56.6	30.2	20.4	78.3	61.7	63.8	47.4	35.8	62.6
Gold Rain	111	93.9	85.9	102.6	46.9	61.2	96.6	28.3	58.6	35.3	23.4	78.3	62.1	64.4	47.7	36.4	63.3
Ligowo	108	88.3	84.1	88.3	48.2	52.4	92.6	23.4	66.1	34.8	20.2	71.2	57.4	60.6	45.5	36.1	59.8
Abundance	97	90.0	85.0	87.5	33.3	55.1	98.6	33.6	52.1	38.1	21.4	(1)				36.3	59.4
Gerlach	104							38.0	64.9	38.1	(2) 26.3	65.3	63.6		49.4	41.8	
Alaska	112							(2) 22.6	39.3	20.5	11.5	43.0	(1)			23.5	
O. A. C. No. 72	119							(2) 23.3	50.4	36.2	16.1	(1)				31.5	
Daubeney	109	78.9	54.5	72.5	46.6	55.1	92.9	(1)					(3)				
Sixty Day	117		65.4	65.9	46.2	67.7	(1)						56.8				
Cole	795												(2) 49.1				

were grown in smaller plots than the Banner so that the yields are comparable with the Banner yields in the smaller size plots. Therefore the yields of Banner given in Table 1 were taken from comparable plots. In 1920, 1921 and 1922 both Gerlach and Banner were tested in the standard variety plots. The average yield from the Banner for this three year period was 52.9 bushels per acre while the Gerlach yielded 51.7 bushels per acre.

Other varieties which have given good results are Victory, Sask. 110, Ligowo, Sask. 108, Gold Rain, Sask. 111 and Abundance, Sask. 97.

The early varieties, such as Sixty Day, Sask. 117, Daubeney, Sask. 109, Alaska, Sask. 112 and O. A. C. No. 72, Sask. 119, have not given satisfactory yields at Saskatoon. There may be a place for these varieties however in the northern and northeastern parts of the province where the seasons are very short and a quickly maturing crop is desired. They may perhaps also be useful in the extreme southwest as there is a possibility that early varieties, by completing the greater part of their growth before the hot dry winds set in, may give the best results. This has not been tried out experimentally in Saskatchewan until the present season and the results are not available, but it is interesting to note that in western South Dakota where the summers are frequently hot and dry, these varieties nearly always give the best yields.

Table II gives the length of time taken for the standard varieties of oats to mature, together with averages, for the years 1917 to 1922 inclusive.

The following notations with regard to some of the more important varieties will no doubt be of interest. The varieties are divided into five groups which may be regarded as types.

Group 1. Open Panicled, Late Maturing

Banner Sask. 99. The exact origin of the Banner oat is unknown. It was introduced to America by James Vick, a seedsman of Rochester, New York. It became known throughout the continent as American Banner and in Canada it soon became and still remains, the most popular sort.

This variety possesses large spreading panicles with many branches which are carried characteristically at an angle of about forty-five degrees from the main culm. The straw is pale yellow in color and of very good quality. The grains are plump, rather long, white in color, and the main oats usually carry slightly bent awns. The two grained type of

TABLE II. SUMMARY OF DAYS MATURING OF STANDARD VARIETIES OF OATS ON FALLOW.

Variety.	Sask. No.	1917. Days Maturing						
		1917	1918	1919	1920	1921	1922	Averages. 1917-1921
Banner	99	91	112	x	92	95	111	97.5
Victory	110	91	113	x	92	93	111	97.2
Gold Rain	111	91	111	x	92	93	110	96.8
Ligowo	108	91	111	x	92	93	110	96.8
Alaska	112	81	104	x	78	81		86.0
Gerlach	104					93	111	
Sixty Day	117						85	
Cole	795						82	

spikelet predominates and double oats occur very rarely.

Gerlach, Sask. 104. These oats were named after Mr. Paul Gerlach of Allan, Saskatchewan, who procured them from North Dakota. While attending a seed fair at Fargo, he obtained a sample of very fine looking oats and on returning to Saskatchewan placed some of them at the disposal of this department. As already noted they have been tested now for a period of six years.

Gerlach oats are very similar in appearance to Banner but differ in having fewer awns in the panicle, and in the grains which are slightly plumper than those of Banner and not quite as long. At present we have under observation a number of pure line strains of this variety that are entirely awnless.

Victory, Sask. 110. The Swedish Plant Breeding Station at Svalof, Sweden, is the home of Victory oats. They are a pure line selection from a variety known as Probstier which had its origin some place in northern Russia. In appearance and yielding power these oats are very similar to Banner and Gerlach. They appear to possess the awned characteristic of Banner and the grain type of the Gerlach variety.

Group 11. Open Panicled, Medium Early.

Abundance, Sask. 97. The Abundance variety is one of the many productions of the Garton Brothers, England. It is fairly popular in Canada particularly on heavy soils as it is shorter in the straw than the varieties of the Banner type and stands up well. The grains are white in color and being very short and plump are attractive in appearance. The main oats usually carry awns.

Swedish Select, Sask. 130. In 1888, while acting as agricultural explorer for the United States Department of Agriculture, Mr. M. A. Carleton brought over the Swedish Select oats from Petrograd, Russia. These oats are very simlar in appearance to Abundance but at Saskatoon the latter variety has given the best yields.

Great Liza, Sask. 898. It is doubtful if these oats should be honored with a distinct variety name as to all appearances they are identical with Abundance. This custom of renaming varieties for advertising purposes is fortunately being abandoned by reliable seedsmen but it was formerly very common practice and much of the time of the field husbandry investigators has been taken up in retesting renamed varieties to determine their merits or lack of merit. It is mentioned here solely for the purpose of warning farmers with regard to a practice which is detrimental to the seed trade in general as well as to the farming public, because it leads to a lack of faith in genuine, improved varieties as well as to a loss of money in the original purchase of the seed and a useless multiplication of variety names.

Ligowo, Sask. 108. The Ligowo oat has resulted from a single plant selection made by Vilmorin of France. It has never been very popular in Saskatchewan, although it has done exceptionally well under certain conditions. At Saskatoon it has practically always been inferior to Banner in yield. It resembles Abundance very closely but the grains are not quite as short and plump.

Gold Rain, Sask. 111. Both Victory and this variety were selected from Probstier, at the Swedish Plant Breeding Station.

The Gold Rain oat is a good yielder, is medium early, and possesses straw of very high quality. The grains are of medium size, and carry rather thin hulls which are yellow in color. This latter characteristic offers no reasonable excuse for discriminating against it as is sometimes done. The color of the hulls has no bearing whatever on the feeding value of the grain.

GROUP III. OPEN PANICLED, EARLY MATURING

Sixty Day, Sask. 117. This variety was procured by the United States Department of Agriculture from the Proscurov Government of Russia. It is very typical of the early groups, possessing fine strong straw, very open panicles, and long thin kernels which are very low in percent of hull and therefore weigh well to the measured bushel.

Kherson, Sask. 115. Kherson oats were obtained by the University of Nebraska from the Kherson Government in Russia adjoining Proscurov where the Sixty Day oats were obtained. Botanically these two varieties are very much alike. In yielding power they are also very similar.

Cole, Sask. 795. These oats were selected from Sixty Day by Professor John S. Cole of the South Dakota Agricultural College in 1907. Owing to their uniformity and extreme earliness they were distributed by Professor M. Champlin, then of the same institution, after being tested for several years and are now quite widely grown in that state where they have given better yields than Sixty Day, owing to the fact that they mature before the hottest weather of midsummer begins. They were tested at Saskatoon for the first time this year. They yielded about seven bushels per acre less than Sixty Days and ripened three days earlier.

Daubeney, Sask. 109. The exact origin of this variety is unknown. Professor C. A. Zavitz of the Ontario Agricultural College obtained them from a farmer by the name of Daubeney after whom the oats were named. They are very similar to Sixty Day oats both in appearance and in yield.

GROUP IV. SIDE PANICLED, LATE MATURING

Leader, Sask. 143. Leader is another of the many varieties produced by the Garton Brothers of England. It is fairly typical of the side or mane oat type but it is not quite as consistent in type as some of the other varieties such as White Russian, Storm King, and Black Tartarian. Heads of the Leader variety vary from the typical side oat type to almost open. It is very coarse in the straw and usually carries a rather high percentage of hull. At Saskatoon, Leader oats have been found to be rather susceptible to lodging and

Banner, Sask., 144. Representing Group I.

Swedish Select, Sask., 130. Representing Group II.

Kherson, Sask., 115, Representing Group III.

have not given as high yields as varieties of the Banner type.

White Russian, Sask. 801. These oats are characterized by their long drooping side panicles, the branches of which are closely appressed to the rachis. The grains are white in color and rather long. This variety gives fairly good yields but is several days later in maturing than the varieties of the Banner type. For this reason it will probably not become very popular in Saskatchewan.

GROUP V. HULLESS OATS.

The hulless oats are so-called because of their thin papery glumes which are quite free from the kernel and are completely removed in threshing.

As a cereal crop the hulless oat does not appear to have a great future in Saskatchewan. It is not as profitable a crop for the market as hulled oats and for feed is of value chiefly for poultry and hogs. As already stated the hulls are a decided aid to digestion, at least for horses and cattle.

There is a possibility that these oats might be used profitably for the manufacture of oatmeal but so far very few of the millers have had any experience with them. Even should they prove a success for this purpose, it is doubtful if they would be a profitable crop as they do not appear to produce as much food material per acre as the hulled oats. The following table gives the average yields of one of the best hulless varieties, Liberty, Sask. 131, as compared with the average yield of Gerlach, Sask. 104, for a three year period, 1919 to 1921 inclusive. The second column, headed Kernel Yield, is obtained by deducting thirty percent from the yield of the hulled variety. As a matter of fact, the percentage of hull is considerably lower than 30 in a good crop year.

Variety		Yield Bus. per acre	Kernel Yield.
Gerlach, Sask.,	104.	46.6	32.6
Liberty, Sask.,	131.	17.6	17.6

Place in the Rotation.

In those sections of the province where wheat is the chief grain crop and the land is fallowed every three years, there is little difficulty in allocating the oat crop to its proper place in the rotation. Obviously it should be the second crop after fallow, the fallow being sown to wheat or winter rye. Where row crops are used as partial substitutes for the summer fallow, wheat or winter rye will follow the fallow substitute and then either oats or

Storm King, Sask., 126, Representing Group IV.

White Russian, Sask., 801, also representing Group IV.

Liberty, Sask., 131, Representing Group V.

barley. In rotations including grasses or clovers, these will usually be seeded down with the oat crop at the end of the rotation.

In many parts of the park belt however where the native grasses are so abundant and the soil still so very fertile that cultivated grasses and clovers are as yet unnecessary, the place of the oat crop in the rotation presents quite a different problem. It is readily acknowledged by the farmers in these parts that oats is a surer crop than wheat, owing to its maturing several days earlier, and an easier and more agreeable crop than barley to handle. For these reasons when prices appear to be normal many of them would like to sow their oat crop on the fallow but find that it grows very rank and lodges easily. Furthermore many fields are badly infested with wild oats and it is almost impossible to grow them all out during the summer fallow year. The wild oat seeds that remain in the soil over winter, germinate in the spring, complete their development, and shed their seeds before the oat crop is harvested.

In order to overcome some of these difficulties the following alternatives are suggested. They may not be at all practicable under certain conditions but in all cases they are worthy of serious consideration:—

1. Winter rye may be used in place of wheat as the first crop after fallow. It will mature very early in the season, usually during the first half of August and any wild oats escaping the summer fallow and coming through with the rye will be still green when the crop is harvested.

2. An early variety of wheat such as Ruby may be used to replace Marquis. The fallow could be cultivated in the spring after the weeds have begun to grow and the wheat seeded around the 15th to the 20th of May. There would be just as great a chance of Ruby wheat coming through to maturity when sown at this date as there would be of Marquis sown early in May.

3. In the drier portions of the park belt where it is necessary to summer fallow every three years an early variety of oats such as Sixty Day or Cole might be used on the fallow. These early varieties have very strong straw and do not produce such a rank growth as the varieties of the Banner type. They are thus less subject to lodging. Marquis wheat might be used as a second crop but if wild oats are very prevalent it would be advisable to grow a nearly six-row barley such as O.A.C. 21.

4. Where lodging is the chief difficulty and the land has not become badly infested with wild oats, grain in rows might be used to take the place of the fallow. Rotations somewhat as follows should work successfully:

No. I. O. A. C. 21 barley in rows.
Wheat or fall rye.
Oats.
O.A.C. 21 barley in rows on second round.

No. II.—Oats in rows for grain.
Fall rye.
Wheat.
Oats or hulless barley for green sheaf feed.
Oats in rows for grain, on second round.

These are merely suggestions, there being many other combinations which could be worked out which would perhaps be better suited to certain conditions.

Growing the Crop.

Preparation of Seed Bed. When oats are sown on fallow ground as is often the case in the park belt areas the preparation of the seed bed will be similar to that for wheat. If the fallow is very compact it is usually advisable to loosen up the surface soil with the disc harrow or spring tooth cultivator, before the oats are seeded. If the soil can be loosened by one or two strokes with the drag harrow the more expensive operations such as discing or cultivating may be quite profitably dispensed with. Where weeds are very prevalent however, a thorough cultivation before seeding is absolutely necessary.

In the majority of cases oats are sown on stubble ground. Fall plowing of the stubble has been found to give the best results in seasons when the moisture is fairly plentiful in the fall so that the ground is in good condition to plow. Perhaps the chief advantage in fall plowing for oats is that it permits early seeding. Then too, the frost mellows the soil during the winter and that is particularly desirable where the soil is heavy. Spring

TABLE III. SUMMARY OF THE INFLUENCE OF THE DATE OF SEEDING ON THE YIELD OF BANNER OATS. YIELD IN BUSHELS PER ACRE.

Date	1914	1915	1916	1917	1918	1919	1920	1921	1914 to 1921	1914-1917 1920-1921
April 20th.....					57.9	48.9				
April 30th.....	69.2	89.7	140.2	38.2	57.9	36.6	36.1	64.1	66.5	72.9
May 10th.....	79.5	88.2	138.5	47.1	68.3	34.9	34.5	61.8	69.1	74.9
May 20.....	66.2	91.2	136.9	34.6	63.3	33.9	34.5	68.8	66.2	72.0
May 30.....	57.4	97.0	114.5	52.9	60.4	32.1	30.1	57.7	62.8	68.3
June 10th.....	48.2	104.4	114.9	37.5			37.5	41.8		64.1

plowing is usually preferable when the previous autumn has been too dry to do a good job of plowing. Spring plowing is often desirable for light lands which might drift during winter if plowed and left bare. In the spring the land is practically always moist and therefore in good condition for plowing.

Both spring and fall plowing should be well harrowed before seeding. Fall plowing requires harrowing once as early in the spring as the ground can be worked. Spring plowing should be harrowed as soon after plowing as possible to check evaporation.

The practice of stubbling in the oat crop is quite common where the land is fallowed every three years. This method is very economical and gives good results when the land is free from weeds and grasses, and from hard spots such as old slough bottoms which never produce good crops unless well tilled.

In short, the seed bed should be firm, free from weeds and the surface worked sufficiently to permit proper covering of the seeds. Whether to pack or not depends upon the condition of the soil. If the seed bed is firm without packing, the latter operation is not necessary. Rain and time are the best settling or packing agents. For that reason early fall plowing and fallow rarely require it.

Time of Seeding. From the results of dates of seeding tests conducted by the Field Husbandry Department it is evident that oats should be sown as early as possible after the danger from spring frosts is passed. The highest yields, as will be noted in Table III, have been obtained from May 10th seedings. As a general rule from May 10th to May 20th is considered the best time to sow. Although not always possible, early seeding is particularly advisable in the more humid sections of the province where rust often does considerable damage.

Rate of Seeding. Rate of seeding tests carried on by this department have given results which at first appear to be rather conflicting. A careful study of the results by years, however, has led us to believe that the yields obtained from the different rates depend almost entirely upon weather conditions. In abnormally dry years the highest yields were usually obtained from the one bushel rate. In very wet years the four bushels rate has given the best results. As a general rule the intermediate rates have on the average given the lowest yields as is evident from the last column of Table IV. This would appear to indicate that the majority of the seasons in which the tests were conducted were either abnormally dry or wet, thus on the average the rates at the extreme limits would be favored.

Obviously it would not be wise to accept the average results as they stand and advise either very light or very heavy seedings, as in this case we would be depending upon the abnormal season and not the average season to give us the greatest returns. Practical experience in farming also teaches us that the best yields are obtained from intermediate rates, two to three bushels per acre. The lower rate would be quite suitable on clean land in the drier parts of the province but a higher rate, two and one-half to three bushels, has proven to be the best in those regions such as the park belt where the precipitation is more plentiful.

TABLE IV. SUMMARY OF THE INFLUENCE OF THE RATE OF SEEDING ON THE YIELD OF BANNER OATS. YIELDS IN BUSHELS PER ACRE.

Rates.	1914	1915	1916	1917	1918	1919	1920	1921	Average. 1914-1921
1 bushel	75.7	137.4	122.4	45.6	59.8	40.7	37.5	73.6	74.1
2 bushels	75.7	94.1	131.8	47.1	50.3	38.3	37.5	72.3	68.4
2.5 bushels	71.3	88.2	126.6	51.5	55.6	42.2	36.0	82.9	69.3
3 bushels	76.5	105.9	137.6	71.3	57.9	44.2	34.5	58.2	73.3
4 bushels	65.8	101.5	149.4	61.8	47.9	40.2	39.0	65.3	71.4

Harvesting. Oats are usually harvested with the ordinary grain binder and the sheaves placed in round shocks. Long shocks may be used with good success if there is danger of the sheaves not drying out properly due to inclement weather conditions, but they must be very carefully made in order to prevent their being blown over during windy weather.

When harvesting oats for the market or for feed it is usually best to cut them when slightly on the green side in order to prevent loss from shelling and to reduce the probability of volunteer oats appearing in the following crop. For seed purposes, however, the grain should be well ripened as practically all samples with a greenish tinge show a remarkable lack of vitality in the germination test.

Diseases of Oats.

Covered Smut and Loose Smut. In oats, both of these diseases have the same life history. The spores from the diseased plants are carried over on the grain and the following year when the grain is seeded the spores germinate and produce mycelium threads which penetrate the tissues of the young shoots and work their way to the tip of the growing plant. When the heads are formed the fungus infects the ovaries of the flowers and a mass of spores develop in place of the grains. These are the spores which carry the disease over to the next crop.

Control measures are simple and very effective. The grain should be thoroughly wetted with a solution of one pound of formalin to 32 imperial gallons of water, and then placed in a heap and allowed to dry before seeding. It is usually not necessary to cover oats with blankets in order to keep in the fumes of the formalin, as is sometimes done with wheat.

Stem Rust: The same fungous organism (*Puccinia graminis*) which causes so much damage to wheat crops also attacks oats when the conditions are favorable for its development. In 1921 the oat crop in many parts of the park belt was seriously injured by this disease. The fungus not only prevented the grains from filling properly by absorbing nourishment from the straw but in many cases it caused such serious physical injury that the stems were easily broken by the rain and wind. As a result many farmers harvested a desperately tangled crop.

At present very little is known with regard to methods of controlling rust. In many cases and particularly on fallow ground, early seeding is advisable. The use of early varieties such as Sixty Day or Cole will also be of value in areas where rust epidemics are very frequent. There may be a considerable difference in the rust resistance of oat varieties but so far we have very little information along this line. The White Russian variety is practically resistant to stem rust but its lateness will probably preclude its use in those regions where rust is most prevalent.

Crown Rust. This disease is somewhat similar to Leaf Rust of wheat. Although fairly common it does not do a great deal of damage. It is caused by the fungous organism *Puccinia Coronata.*

Conclusion.

The above discussion has been prepared for the purpose of supplying the latest and most accurate information on the growing of the oat crop. It is to be hoped that the discussion will be of at least some value in increasing the quantity and in improving the quality of the oat crop in this province.

The Field Husbandry Department is endeavoring to be of assistance to the farmers in other ways than in the supplying of information deduced from experimental results. A number of pure line strains of grain have been produced through many years of careful selection and isolation, which when distributed by this department are eligible for registration as elite stock. Limited quantities of seed of these strains are available for distribution each year at moderate prices. One of these strains Banner, Sask. 144, is a selection of the original Banner, Sask. 99 and is particularly recommended for Saskatchewan conditions.

Summary.

1. Most of the commonly grown varieties of oats originated from the wild oat (*Avena Fatua*).

2. Canada produces about ten percent of the world's oat crop. Over one third of this amount is produced in Saskatchewan.

3. The oat crop may be used, first, as a straight grain crop, second, in cultivated rows as a partial substitute for the summer fallow, third, as an annual hay crop, fourth, in mixtures for annual pastures and fifth, as a nurse crop for grasses and clovers.

4. The leading varieties of oats are as follows:—

1. Banner and Gerlach, of the open panicled, late maturing group.
2. Gold Rain and Abundance, of the open panicled, medium early group.
3. Sixty Day and Cole, of the early group.
4. Leader, of the side panicled group.
5. Liberty of the hulless group.

5. Oats require a firm seed bed, reasonably free from weeds. Good rotations will make it easier to give timely and thorough tillage.

6. Early seeding has given the best average returns in bushels of grain per acre but later seeding is often satisfactory for sheaf feed.

7. The rate of seeding must be varied in different localities depending upon the probability of plentiful moisture and the fertility of the soil.

8. Oats should usually be harvested slightly before maturity, but the seed plot should be well ripened.

9. Smut of oats may be easily controlled by the formalin treatment.

10. Little can be done towards the control of rust in oats but early seeding and the use of early varieties will help.

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A Note on the Terminology descriptive of the Presence or Absence of the Hulls of Timothy Seed.

BY R. NEWTON.

University of Edmonton, Alberta.

On page 340, volume 2, of this journal, there appears a note on "Hulled and Unhulled Timothy Seed", which, besides conveying interesting information, serves to draw attention again to the ambiguous terminology used by many writers in referring to the adherence or non-adherence of the lemma and palea to the caryopsis of a timothy seed. There seems no reason why we should depart from the practice well established in the case of barley, where "hulled" barleys signify those in which the hull is retained, and "hulless" barleys those in which the hull is lost. In the citation just given, the term "hulled" appears to be used in a sense exactly opposite to that accepted in the case of barley, that is, the writer uses it presumably to describe seed which is naked or "hulless". In like manner the term "unhulled" is probably meant by the writer to convey the same meaning as he would express in the case of barley by the term "hulled". Such confusion is needless, since the terms "hulled" and "hulless" when conjoined are perfectly clear and explicit in their meaning, and they have moreover the authority of usage from at least the time of Körnicke onwards. A plea for more uniformity and exactness in terminology seems to be in order.

ERRATUM.

page 119 of the November issue, a
us mistake was made in the ar-
ement of column headings for
e 4. These headings are given cor-
y in the table reprinted below. It is
ested that readers cut out the com-
Table, or the headings, and paste
in their proper place on page 119.

ble 4.—Variety test with timothy.

Per Cent Germination	Per Cent Purity	1000-Kernel Weight	No. of Kernels Per Gram	Amount of Seed Sown
98.5	100	.57	1755	13.0
95.5	100	.51	1960	12.0
99.0	100	.60	1665	13.5
98.0	100	.59	1695	13.5
98.0	99.2	.44	2270	10.0
99.5	100	.67	1495	15.0
98.5	99.7	.46	2175	10.5
98.5	92.7	.53	1885	13.0
99.5	100	.60	1665	13.5
98.5	100	.56	1785	12.5
94.0	100	.65	1540	15.5
99.0	100	.52	1925	11.5
99.0	100	.35	2860	8.0
98.5	100	.52	1925	12.0
98.5	100	.53	1885	12.0
98.5	100	.47	2150	10.5
99.5	100	.48	2085	11.0
97.5	100	.47	2150	11.0
95.0	100	.65	1540	15.0
99.5	96.6	.49	2040	11.5
88.0	98.2	.39	2565	10.0
86.0	98.9	.35	2860	9.0
96.5	98.3	.44	2275	10.5
97.5	99.7	.43	2325	10.0

The Possible Period of Usability of Milk.

Some observations on this Phase of the Problem of Milk Spoilage.

BY MARION J. MOUNCE,

University of British Columbia, Vancouver, B. C.

(Paper read before the British Columbia Branch of the C.S.T.A., April, 1922)

The science of Dairying is not lacking in problems which challenge investigation. Many or most of them are intimately associated with the fundamental question of the *quality of milk*. The cleanliness, healthfulness, the nutritive value of milk may, perhaps, be assured by legislation but of what worth are these, unless keeping quality also is guaranteed? Sound legislation dealing with the keeping quality of milk, must be based on something other than probabilities and inferences. The problem of milk spoilage calls for investigation into the length of time involved in the clotting of milk and the spoilage of milk and into the varieties of bacteria associated with these changes. An investigation into the possible "period of usability" of milk was commenced in 1919 by Wilfred Sadler and Marion J. Mounce. The object has been to secure data with respect to the milk produced in British Columbia in order that the accumulation and interpretation of such data may make possible, firstly, the offering of advice on the important question of milk spoilage, and secondly, a diminution in the extent of that spoilage. In a recent publication on "The Spoiling of Milk" by Sadler and Mounce, (1) a report of the early phases of the work is submitted.

At the request of the University administration a Report of Progress has been prepared, wherein the development of the work during the period extending from June 6, 1921 to February 7, 1922 is presented. The data secured during the same period is discussed. Obviously, such a report would not be for publication at present, but to facilitate comprehension of the nature and extent of the investigation, a brief outline of some sections of it may be included here.

During this period an examination of the mixed milk of the University herd has been carried on. The principal test employed is the "Fermentation Test" or "Clotting Test", supplemented and interpreted by the determination, quantitative and, to some extent, qualitative, of the bacterial content.

The daily procedure is as follows:—

A. *Clotting Tests.*

Samples of the mixed morning's milk are taken in sterile test tubes, and incubated at 37½°C. and at 21°C, under both aerobic and anaerobic conditions. The mass reactions are recorded at suitable intervals.

B. *Determination of the Bacterial Content.*

The bacterial content is determined quantitatively by the classic plate method and by the direct microscopic count of bacteria. The presence of organisms of the colon-aerogenes group is determined by the plate method, using differential media, and by the presumptive test.

The original plan was that all of the work should be done in triplicate but variations in reaction exhibited by samples of the same series are so frequent and so marked that it becomes imperative to record each sample separately. One hundred series of milk samples, consisting of five hundred and ninety six individual samples, have been subjected to the clotting test at 37½°C. Twenty-seven series, or one hundred and sixty-two individual "clotting" tests at 21°C, are recorded. Sixty-three examinations of the bacterial content of the milk have been made by the plate method; sixty by the direct microscopic count; thirty-eight more films have been prepared but the counts are not yet available. Eighty-five examinations for colon were made, forty by the plate method, forty-five by the presumptive test.

(1) The Spoiling of Milk by Wilfrid Sadler and Marion J. Mounce, 1922. Scientific Agriculture, Vol. II, No. 7, Pages 213-224, Gardenvale, P. Q.

These records have been worked over to ascertain the "period of spoiling", that is, the period elapsing between incubation and the first visible evidence of spoilage, whether it be the formation of a clot or the peptonization or "dissolving" of the casein. The relation between the "period of spoiling" and the bacterial content has been studied and also the relative efficiency of the various methods employed as tests for the quality of milk.

The results of the "clotting tests" exhibit several interesting features. Most noticeable perhaps is the wide variation apparent in the "period of spoiling" recorded for various samples. Variation from day to day in the period of spoiling of the milk from a herd is to be expected, but such a marked difference in "period of spoiling" of presumably identical samples was not anticipated. If it prove possible to record reactions of the samples at considerably briefer intervals and to keep quite distinct the time of "clotting" and the time of "dissolving" the disparity may be lessened; at any rate the "period of clotting" will be a more definite quantity and a more usable one than it is at present. The temperature at which the "clotting" tests should be conducted affords another subject for discussion. So far most of the tests have been made at a temperature of 37½°C. While this is admittedly a standard one for the examination of milk (2), since it has been possible, through the purchase of a "room temperature" incubator to conduct the tests also at a temperature of 21°C. there have been intimations that very valuable data will be available. It would appear that these two temperatures, favoring as they do the growth of different groups of bacteria, give widely different end points to the "clotting tests" and the establishment of the relation between the results at each temperature would in itself, be profitable. There is the possibility also that the definite relation apparently existing between the colon content and the "period of spoiling" as now recorded is a consequence of the temperature employed for the "clotting" tests.

Incubation at both temperatures seems desirable in the determination of the bacterial content by the plate method. That the plate method as employed heretofore has not proven satisfactory, is revealed by a comparison of the counts obtained by the plate method and by the direct method. By trials of additional and new types of media, of various periods of incubation at either and both of these temperatures, it is hoped that an optimum combination of medium, temperature and period of incubation will be evolved which will result in a plate count as nearly as posible representative of the true bacterial content.

The probability is that the error has not lain altogether with the plate method. In the use of the direct method a great handicap has been the lack of a reliable methylene blue stain.

This difficulty has, we hope, at length been satisfactorily solved, and results of the direct count which will confirm and support the results of the plate count are now looked for.

That further methods of examination, in addition to those already employed, should be adopted seems desirable. It is proposed in the immediate future to make use of such tests as the Brom Thymol Blue test according to Cooledge, (3) the Brom Cresol purple test of Baker and Van Slyke, (4) and the Methylene Blue test of Barthel (5).

With regard to the continuation of the project, it seems that data must be secured sufficient to lend to the conclusions based on it, a degree of finality; that milk of widely varying quality must be examined; that an endeavor must be made to determine the test or combination of tests which might most suitably be employed for the grading of market milk. The chief end of the investigation, the end not to be lost sight of, is the accumulation of sufficient data of such nature that conclusions based on it may lend to the term "possible period of usability of milk", a degree of definiteness which it does not now possess.

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(2) A. P. H. A. 1921. Standard Methods for Bacteriological Examination of Milk. p. 14-18. Boston.

(3) L. H. Cooledge. 1921. The Colorimetric Hydrogen Ion Determination as a Means of Studying Biological Changes in Dairy Products. Tech. Bull. No. 52, Agr. Exp. Sta. East Lansing, Mich.

(4) J. C. Baker and L. L. Van Slyke, 1919. Tech. Bull. No. 71, N. Y. Agr. Exp. Sta., Geneva, N. Y.

(5) Barthel, 1910. Milk and Dairy Products. P. 128, Macmillan & Co., London.

Plant Distribution as Related to Climate.

An Abstract Prepared by

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The subject of plant distribution as related to climate has recently been dealt with in a comprehensive monograph by Livingston and Shreve (1). Their study has been confined to data collected in the United States, but the methods employed and the conclusions reached are of interest and application wide enough to merit the attention of all ecologists and plant physiologists. A brief summary of the outstanding points is given in the following pages.

In their preface the authors discuss the present trend in plant geography, pointing out that the subject of plant distribution and that of the relation of a plant to its environment have coalesced to form the subject matter of ecology. The physiologist has thus far been interested mainly in the individual processes of the plant as affected by environmental conditions acting singly, i.e., the *absolute* value of conditions .The ecologist is interested in the collective activities of the plant, as controlled by the entire set of environmental conditions, i.e., the *relative* value of conditions.

Subterranean conditions have not yet received enough attention to make even a tentative description possible. Accordingly, attention has been confined to factors operative above the soil surface.

Throughout their work the authors have maintained the viewpoint of physiology, and insisted upon quantitive methods, believing that little further progress is possible in plant geography by qualitative observations. The subject as they view it may be called "quantitative physiological plant geography." The important practical fact is noted that agriculture rests almost wholly upon the physiological ecology of animals and plants.

(1) Livington, B.E., and Shreve, F. The Distribution of Vegetation in the United States, as Related to Climatic Conditions. Carnegie Inst. Wash. Pub. 284 (1921). Pp. XVI + 590, pls. 73, figs. 74.

The monograph is divided into three parts, the first dealing with the vegetation of the United States and its distribution, the second with environmental conditions in general and the climatic conditions of the United States in particular, and the third with the correlation of distributional features with climatic conditions.

THE VEGETATION OF THE UNITED STATES.

After noting the various methods for classifying vegetations (floristic, physiographic, etc.) the authors argue for classification on a physiological basis. Plants associated in given regions may have very dissimilar distributional controls, as indicated by their separate occurrence in other regions.

Phylogenetic classification is based chiefly on the floral organs, but ecological classification requires first attention to the vegetative organs. Ecological similarity often exists between plants of distant phyletic relationships, and *vice versa.* Future investigations may enable us to distinguish between structural features of physiological importance and those merely due to evolutionary inertia; for example, the size and shape of leaves are not definitely related to transpiration.

The existence, limits and movements of plant communities are controlled by physical conditions. Climate controls the broader geographical limits, but soil conditions affect local distribution. Only recently has work been undertaken on physical conditions which underlie successional stages.

The authors use maps to show the distribution of vegetational types, as well as of groups of plants of the same growth-form, and of individual species, with regard both to extreme distribution and to regions of greatest abundance. Distributional data were obtained from ecological, floristic, and geographical literature, including the maps of

the United States Forestry Service and of the Bureau of Plant Industry, the publications of the Geological Survey, all manuals, floras, and local lists available, and from photographic illustrations in works of a non-botanical character. Vegetational areas are delimited by drawing lines through transitional areas, connecting points which exhibit the same stage in transition, after the manner of isoclimatic lines.

The generalized vegetation map of the United States shows the following nine vegetational areas:—

1. Desert.
2. Semidesert.
3. Grassland.
4. Grassland—deciduous forest transition.
5. Deciduous forest.
6. Northwestern hygrophytic evergreen forest.
7. Western section of the northern mesophytic evergreen forest.
8. Eastern section of the northern mesophytic evergreen forest.
9. Southeastern mesophytic evergreen forest.

As examples of the growth-forms and individual species of which the distribution was studied and mapped, may be cited, in the former case, evergreen broad-leaved trees and eastern deciduous trees, and, in the latter case, the loblolly pine *Pinus toeda* and buffalo grass *Bulbilis dactyloides*.

ENVIRONMENTAL CONDITIONS.

The United States Weather Bureau has accumulated a vast amount of data, especially in regard to temperature and rainfall, of which the authors have made full use. Unfortunately no corresponding data for plant activities are at hand. The information available refers chiefly to the ability or inability of plants to withstand frost, and to survive and grow under given limitations of water supply.

Though soil conditions are not dealt with, it is pointed out that physically the soil is a medium through which climate acts upon plants, though chemically it may introduce other important factors. It is pointed out also that competition between plants merely modifies local climatic conditions, with reference, for example, to moisture and light.

Responses are quite as dependent upon the nature of the responding organism as upon the nature of the stimuli. There are thus two sets of conditions, external and internal, the latter of which serve to define the plant physiologically. The relation of the plant to external conditions is complicated by a sequence of phases in the plant's history; conditions favourable to germination and growth may be unfavourable to fruiting. The time factor is also a complication; e. g., conditions for etiolation are present every night, but do not persist long enough to be effective. Again, the various factors are interdependent; changing one only may produce no change in the plant, or may on the other hand modify responses to other factors also.

There is a wide divergence in the physiological limits of the resting and vegetative stages of the plant. This is strikingly shown in the endurance of cold and heat by seeds and spores as compared with growing tissues. The various physiological processes—photosynthesis, respiration, digestion, secretion, etc.—has each its limits. A combination of the duration or time factor with that of intensity is nearly always the effective condition.

The limits for life, growth or reproductive activity define the resisting power of a plant. Resistance to any one condition is, however, markedly influenced by other conditions, e.g., the less water a seed contains, the greater its resistance to both cold and heat. The intensity limits for life are wider than those for growth and reproduction. But given suitable growth conditions, in order that a plant may succeed in a given region, there is still required a length of season sufficient to ensure reproduction. Adverse periods may then be bridged by seeds or spores. However, the life-limits of the seeds may still be surpassed, and the plants perish, as in the case of many cultivated plants which do not volunteer the second season.

The authors discuss in some detail the following chief environmental factors:—moisture, temperature, light, chemical and mechanical conditions.

Plants require water for growth, photosynthesis, hydrolysis, and above all for transpiration. The rate of transpiration depends upon the structure and condition of the transpiring parts, the evaporating power of the air, and the intensity and quality of illumination. The supply of water through the roots is primarily affected by the rate of water movement through the soil; the soil immediately in contact with the absorbing surfaces may become drier than the remainder. However, in periods of high evaporation plants may cease to grow even in soil of optimum moisture content, if the capacity of roots and stems for transmission is surpassed by transpiration.

Plants vary greatly in their ability to withstand dry conditions. Many water-storage plants of the desert can retain vitality and maintain a reduced transpiration for several years after they have been removed from the soil.

Growth depends on the relation between water requirement and water supply. When the ratio of supply to demand is greater than unity, growth may occur; when it is unity, growth must soon cease but form and vitality may be retained; when it is less than unity, incipient drying occurs, the end result depending on the time factor. Non-available soil moisture has often been treated as a constant, but actually varies within wide limits, according to the transpiration rate for the period during which wilting occurs.

"Physiological dryness," the condition where a plant apparently suffers from drought in a moist or even wet soil, is usually due to a pathological condition of the roots, or to a too high osmotic pressure of the soil solution. Plants tolerant of "alkali" are those having unusually high osmotic pressure in absorbing organs.

With regard to temperature requirements, the innumerable physical and chemical processes of the plant must be thought of as having each its temperature limits. With falling temperature, growth in size is first checked; then cell division and photosynthesis, then respiration. The limits for vigorous activity in different plants range from 0°C. to 60°C. Probably the majority of elementary chemical processes of living things follow Van't Hoff's rule that a rise of 10 degrees centigrade multiplies the rate of reaction by 2 or 3. However, Russell (1) states that it does not hold for the complex resultant, rate of growth. The operation of the law of minimum may interfere. Lehenbauer (2) found the rate of growth of maize seedlings to be increased 6.56 times by a temperature change from 12°C. to 22°C., about 2 times from 22°C. to 32°C. and 0.06 times from 33°C. to 43°C., the growth measurements being for a period of 12 hours in all cases.

The light relation of plants is complicated by the fact that not only the light intensity but also its quality may vary. The intensity is measured by the number of calories received by a blackened surface per square centimeter per unit time. The quality depends on the range of wave-lengths, and the relative intensity of different portions. The heating effect of light is seldom of primary importance, this place being reserved for its morphogenic and photosynthetic functions.

All vital activity is material change of some sort. Thus the quantitative and qualitative relations between chemical substances of the plant and its environment are continually changing. Diffusion tends to bring about concentration equilibrium, but this is modified by permeability of the plant periphery, and by transformations and translocation within the plant. Above the soil surface chemical conditions are strikingly uniform; below the surface conditions may vary from those of washed sand to those of alkali soils. However, in most ordinary soils the quality and concentration of the solution does not vary much with respect to inorganic compounds, but does in amount and kinds of organic matter.

The authors point out that no plant has ever yet been studied with even approximate control of all the influential conditions of its surroundings, and that for a true appreciation of the relations between plant and environment, all of these conditions must be quantitatively known.

1 Russell, E. J., Soil Conditions and Plant Growth, 3rd ed., 1917.

2 Lehenbauer, P.A., Physiol. Res. 1: 247-288. 1914.

THE CLIMATIC CONDITIONS OF THE UNITED STATES.

Temperature.

The length of the growing season is the most important climatic factor in determining species distribution, and this is usually limited by temperature, though in arid regions it may be determined by moisture. On the other hand, it is probable that some plants are excluded from certain localities, not by insufficient length of growing season nor by killing temperature, but by too great length of dormant period.

The authors have arranged in the form of tables and charts (maps divided into climatic provinces by equiseasonal lines) the information accumulated in the meteorological literature of the United States with reference to the following temperature values:—

Length of average frostless season (at 1803 stations).

Length of period of high normal daily mean temperatures.

Length of period of low normal daily mean temperatures.

Absolute temperature maxima.

Absolute temperature minima.

Mean temperature for coldest 14 days of year.

Mean temperature for hottest 6 weeks of year.

Mean annual temperature.

Believing the development of environmental formulae to be the legitimate end of investigations such as these, the authors make use of a number of temperature efficiency indices.

Direct efficiency indices are numerically the same as temperature readings, and assume that growth is directly proportional to temperature. These values have little promise in physiological studies, since what requires to be considered is temperature effectiveness on plant activities rather than the temperatures themselves.

Remainder efficiency indices constitute a scale with graduations of the same magnitude as a thermometer scale, but with the zero shifted to coincide with the point at which growth just ceases. This form of index is due to Merriam (1).

Exponential efficiency indices are based on Van't Hoff's law. Taking 6°C. as the point at which growth rate is unity, they are derived by the formula $I = 2^{\frac{t-6}{10}}$, where I is the efficiency index, and t is the temperature centigrade. This formula is of course applicable only from minimum to optimum temperatures.

Physiological efficiency indices were in this case derived from Lehenbauer's data for growth-rates of maize seedlings at various temperatures. Plotting growth rates as ordinates and temperatures as abscissae a curve is obtained giving indices ranging from zero at 2°C., through a maximum of 122.3 at 32°C. to zero again at 48°C.

Summation values are obtained by adding together the index values for each day of the frostless season. In the case of the direct indices, this amounts to the summation of the mean daily temperatures. The other indices involve additional computations. The authors then chart the United States according to the summation values for these indices at the various observing stations. They point out that by the remainder indices one would expect, for example, 4.8 times as much plant activity at Key West as at Sault Ste. Marie; by the physiological indices the apparent range in seasonal temperature efficiency between these two places would be still greater, about 5.6 to 1. It is interesting to note that the zonation of the country on the basis of the frostless season agrees in a general way with its zonation on the basis of physiological temperature indices.

Moisture.

The consideration of precipitation includes the following headings:—

1. Mean daily precipitation for frostless season. On this basis the country is divided into arid, semi-arid, semi-humid and humid provinces.

2. Precipitation for frostless season plus preceding 30 days (rainfall being cumulative in effect).

3. Number of dry and rainy days in frostless season (0.1 inch taken as dividing line).

1 Merriam, C.H. Nat. Geog. Mag. 6: 229-238 1894.

4. Lengths of longest rainy and dry periods in frostless season. In southern Arizona there are two periods of active plant growth during the frostless season, (a) from about March 26 to May 1, utilizing residual soil moisture from the winter, and (b) from about July 1 to October 15, during the summer rainy period and about a month of residual effect.

5. Annual precipitation. This gives a general estimate of the aridity or humidity of a region.

It is found that precipitation zones in the United States tend to run north and south, while temperature zones tend to run east and west.

The removal or loss of water from a plant depends chiefly on two factors of the aerial environment, the evaporating power of the air and light intensity. The former is more important, and depends in turn upon the temperature, humidity and velocity of the air.

Only two logically planned series of measurements of the evaporating power of the air, in which suitably calibrated atmometers were used, have been carried out in the United States—one by Russell (1) in 1887-88, and one by the authors in 1908.

These meagre data are dealt with exhaustively. The evaporation totals for the year, the three summer months and various shorter periods are tabulated. The evaporation intensity for the frostless season, E/S, is obtained by dividing the number of days into the total evaporation for the period. The Transeau (2) ratio of precipitation to evaporation, P/E, is calculated for periods of various lengths. Using the values for a large number of stations, calculated as indicated in a variety of ways, the map of the country is divided into arid, semi-arid, semi-humid and humid provinces by isoatmic lines.

The data for aqueous vapour pressure and relative humidity collected by the United States Weather Bureau are carefully worked over, and furnish, especially in the case of relative humidity, a rational climatic zonation of the country. The authors point out, however, that greater value would attach to such data reported in the form of vapor-tension deficits, which combine in a single function the factors of air temperature and humidity.

Wind is the main external condition governing transpiration rate. It affects also the rate of water loss from the surface of the soil. With low wind velocities the affect of alteration is great, but with high velocities this effect practically vanishes.

Data indicating the effect of light on evaporation were lacking, with the exception of ordinary sunshine records. The authors suggest the use of the Livingston radio-atmometer, which consists of two spherical porous-cup atmometers, one black and the other white, but otherwise identical.

Moisture-Temperature Indices.

On the assumption that the temperature efficiency of a climate is proportional to the temperature summation-index, and that the moisture efficiency is proportional to the Transeau ratio of precipitation to evaporation, the authors have derived the moisture-temperature index I_{mt} as a measure of climatic efficiency to produce plant growth. This index is a product of the temperature summation index I_t and the Transeau ratio m. From a consideration of the formula it will be plain that the magnitude of this index is greatest with a long growing season, with high temperatures (not surpassing the optimum), with great rainfall, and with low evaporation.

Zonation of the country by these indices shows peninsular Florida, Cape Hatteras, and the very humid northwest to have the highest values, while the Great Basin and the arid deserts of Arizona and southern California belong to the area of lowest values. The values are largely controlled by moisture in the arid regions, and by temperature in the cold regions. It is pointed out that these indices do not represent plant distribution, but the climatic possibilities for plant growth.

As a result of their study of climatic conditions, the authors conclude with regard to temperature that the length of the average frostless season is the best duration factor and the summation of physiological indices

1 Russell, T., Monthly Weather Rev. 16: 235-239. 1888.

2 Transeau, E.N. Amer. Nat. 39: 875-889. 1905.

for the frostless season is the best intensity index. The mean daily precipitation for the frostless season is probably the most important moisture index, though the Transeau ratio of precipitation to evaporation is of great value.

The Correlation of distributional features with climatic conditions.

The authors report in this section their attempts to ascertain the relative influence of each climatic index in controlling the distribution of a given vegetation or plant. Each of 39 climatic maps, showing zonation on the basis of the various climatic indices used, was overlaid in turn with tracings of 33 botanical maps, showing distributional areas of the species and vegetations studied. The climatic index figures for the stations showing the lowest and highest values within each plant distributional area were read, and the readings for each species or vegetation tabulated separately. Two groups of graphs are presented. Each graph of the first group shows the limits of some one climatic factor for each of the generalized vegetational areas; each graph of the second group shows the limits of the 17 leading climatic factors within the distributional area of some one vegetation or species.

Where the range of values between maximum and minimum is large, it indicates that the climatic factor in question does not exert an important controlling influence on the distribution of the vegetation concerned. Conversely, the smaller the range, the more important is the probable influence in limiting distribution.

It is found that many species or vegetations are subjected to one-third to more than half of the entire gamut of differences shown by the climatic conditions of the United States. However, the fact that a given plant is able to withstand a particular climatic intensity does not mean that it can endure it throughout the distributional range of that intensity; e.g. certain cacti can withstand lower temperatures in dry regions so in these circumstances extend farther north than is possible in humid regions.

The tables and graphs noted above throw considerable light on the conditions which probably determine the vegetational areas. The authors point out also the general correlations of vegetational areas with climatic provinces.

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Free Distribution of Grain.

A free distribution of superior sorts of grain will be made during the coming winter to Canadian farmers by the Cereal Division of the Experimental Farms Branch, Ottawa. The samples will consist of spring wheat (about 5 lbs.), white oats (about 4 lbs.), barley (about 5 lbs.), field peas (not garden peas, about 5 lbs.), field beans (about 2 lbs.), flax for seed and flax for fibre (about 2 lbs.).

The Cereal Division of the Experimental Farms Branch has improved many of the old varieties of grain and introduced many new varieties. The best of them have been multiplied and propagated under direct supervision of responsible officers on the Experimental Farms both east and west. This seed will form the bulk stock from which the various samples will be taken. The seed is therefore the purest and best that is obtainable. Of some of the more recent introductions, there is only a limited supply, so it would be advisable to apply as soon as possible for these.

Application must be made on a printed form which will be supplied by the Cereal Division, Central Experimental Farm, Ottawa. (No postage is required on letters so addressed). No application forms will be supplied after February 15th, 1923. Farmers are advised to send at once for forms in order not to be disappointed, as in some cases the stock is limited. The allotment of samples will be made in order of application. Only one sample will be sent to a farm.

Improvement of Fodder Corn for Manitoba and other Prairie Provinces.

BY W. SOUTHWORTH,

Manitoba Agricultural College, Winnipeg.

Introduction.

At this station, improvement work with corn has been conducted for the purpose of trying to develop a strain or a variety of corn which will give a fair yield of fodder and, at the same time, produce mature seed in an average season in Manitoba.

Owing to our short seasons together with risk of late frosts in spring and early frosts in autumn*, the advisability of producing our own seed corn in Manitoba has sometimes been questioned and it has been suggested (not unreasonably) that we should rely on corn growers in the United States to raise our seed corn.

These growers, it is argued, with their superior climate and longer growing seasons are in a much more favorable position to produce good seed corn than we can hope to raise ourselves. On the surface, this arrangement would seem to be both feasible and desirable; but there are other circumstances intimately connected with the subject, which should have careful consideration.

Those who have had experience in testing varieties of corn in these northerly latitudes are well aware that varieties and strains of corn which succeed best farther south are not so well adapted to succeed under our conditions as those which have become more or less acclimatized.

This fact has been forcibly brought home to corn growers in Manitoba, who have had the misfortune to obtain seed corn from strains or varieties quite unsuited to local conditions. In some cases, the result has been a crop of forage consisting of watery stems and leaves with undeveloped ears yielding a crop with a high percentage of water and having a correspondingly low feeding value.

It will readily be seen that such watery material costs as much per ton to put into the silo as does fodder of high quality; also a large percentage of this immature corn runs away to the drains and that which remains in the silo has not a high feeding value.

When experiences of this sort are encountered, we need not feel greatly surprised if we find that some farmers are not so enthusiastic for fodder corn as they might be if they had grown their crops with seed from an acclimatized strain and well adapted to local climatic conditions.

The many advantages to be derived from producing our own seed are so obvious that we need not take time and space to enumerate them. If, however, we consider the advantage of growing an early-maturing corn simply from the point of view of producing fodder corn, we shall readily see its immense value to the Prairie Provinces.

By carefully conducted experiments, American investigators have been able to show clearly that the food nutrients in the corn plant continue to increase until the seed is mature.(5). In view of these experimental results, we may conclude that in order to obtain a fodder corn having a high feeding value it is necessary to plant a variety which will, when required, mature seed in an average year and will also attain to a sufficient degree of maturity to produce a crop of good quality silage corn when the season falls below the average

At this station, in five of the past seven seasons, we have had excellent crops of mature seed corn. This being so, we believe we are safe in saying that with early maturing varieties the farmers in most parts of the Province are well able to grow sufficient

*The average length of our growing season without a killing frost is taken to be about 100 days.

(5) Figures in brackets refer to literature cited at the end of the article.

seed-corn in the average years to carry over the occasional seasons which are too cool or too short to produce ripe seed.

Corn Improvement Work Since 1916(7).

This report deals with the work conducted during the past six years (including the season of 1916).

In 1916, the seed-corn left over from previous years was used. The ears had been taken from the Yellow Flint, variety Quebec 28. In examining the seed-corn before planting, it was observed that the ear characteristics varied considerably from the Quebec 28 type. These variations were probably due to the Quebec 28 having been previously cross-fertilized by other Flint varieties (Free Press and Gehu which were growing at that time in nearby plots.)

As would naturally be expected, the crop produced in 1916 showed great irregularity both in regard to height of stem, position of ear on stem and in regard to date of maturity. The ears were also very variable both in length and in circumference. The number of rows per ear varied from eight to eighteen or twenty—the majority of ears having twelve rows.

Improvements Desired.

It was considered at first that early maturity should receive the chief attention. With this in view, it was recognized that a medium-sized ear with not too many rows would be most likely to give the best all-round results, and so in selecting seed in the earlier years, medium-sized, well-matured ears having twelve rows were the chief points taken into consideration.

Planting: The method practised is the ear to row plan. Planting is usually done around the 24th of May. The rows are arranged three feet apart, and the seed spaced one foot apart in the rows. The seed is planted with a hand corn-planter adapted for the purpose, and two good seeds are dropped in each place. If

FIG I.—MANITOBA FLINT CORN (growing crop) seed planted May 25. Crop mature on Sept. 4, 102 days. Average height below tassel 47 inches.

both seeds germinate, they are allowed to grow until they are four or five inches high; then the weaker plant is removed. This system of planting serves a double purpose:—

Firstly: it gives a much better opportunity to obtain a uniform row so that each plant has the same amount of space both above and below the ground.

Secondly:by taking out the weaker plant and leaving the robust one, we have reason to believe that we are gradually building up a strain which has an increased ability to germinate and to make an appreciable growth at lower temperatures than seed-corn produced in a warmer climate.

In order to put this question to a definite test, it was decided to see what germination power the seed possessed when subjected to constant low temperatures kept strictly under control.

In the carrying out of this work on germination, we were fortunate in securing the cooperation of Mr. Sidney S. Carney of the Crop Production Department, University of Illinois, to whom we feel very greatly indepted for his kindness in personally conducting these germination tests and for supplying the following tabulated statement setting forth clearly the results obtained.

The following table gives the comparative results of germination tests of seed-corn of North-western Dent and Manitoba Flint (both grown in Manitoba) and Reid's Yellow Dent grown in Illinois.

Germination of Corn at 10° C:=50° Fah. Planted on April 6th 1921.

Date of Reading	North-western Dent Radicle.	Germinated.	Manitoba Flint Radicle.	Germinated	Reid's Yellow Dent Radicle	Germinated
April 12	1	0	0	0	0	0
" 13	5	0	1	0	0	0
" 15	5	0	1	0	1	0
" 16	7	0	3	0	1	0
" 18	7	0	5	0	2	0
" 19	7	1	5	0	2	0
" 20	7	1	5	0	3	0
" 21	7	1	6	0	3	0
" 22	8	1	7	0	6	0
" 25	10	5	10	2	11	0
" 26	11	5	11	2	12	0
" 27	11	7	11	2	12	4
" 28	11	8	11	3	12	4
" 30	11	8	12	8	12	6
Per cent Germinated.		75		75		50

"Mr. Carney reports that the above tests were conducted in Dr. Hottes' laboratory. The temperatures used were 5° C.=41°F and 10° C. =50°F. These temperatures were maintained throughout the tests in constant temperature cases. Twelve kernels of each variety were used.

The results of the tests, although not extensive enough to warrant definite conclusions, seem quite significant to me; since I was able to read the tests daily. The rate of germination at 10°C. was more significant than the final per cent germination and, as shown by the table, was in favor of North-western Dent. None of the corn germinated at 5°C.—although in North-western Dent, one radicle was produced."

Development of Selection Methods.

After about three years' work, a marked improvement was noticed in the uniformity of the corn both in the ear and on the field. Greater care was then exercised in the work of selection. Under this system, more attention is paid to the character of the growing plants in the field from which the seed grain is to be obtained. Inferior plants are detasseled; for example, the growing crop is examined, and plants lacking in vigor and robustness, or those of a decidedly dwarf habit, and plants which have the ears situated too low down on the stalk are detasseled. in some cases, whole rows which show a general inferiority have the tassels removed.

Previous to harvesting, a count is made of the number of plants per row. An estimate is also made of the relative amount of suckers produced on each row: this information together with the height will give a general idea of the value of the row from the fodder view-point before husking; then, after harvest, the actual weight is readily obtained.

In husking, the ears from each row are kept separate. They are also sorted into two grades: one for mature, and the other for immature, ears. The ears in each grade are counted and weighed, and, from these counts and weights, the percentage maturity is estimated.

By working the above system, a strain of corn has been produced, which—though

we cannot regard it as being pure-bred yet—reproduces sufficiently true for all practical purposes. Having regard to the modification brought about by allowing the Quebec 28 to intercross with the varieties Gehu and Free Press, the modified strain is now known as Manitoba Flint.

Chief Characteristics of the Strain—It is a twelve-rowed, early, yellow Flint; ears six to eight inches long; cob, white; kernels, small; stems, average,—four to five feet below tassel; leaves and suckers abundant. (fig. 1).

In order to present a concise statement of the improvements that have been introduced into this strain of corn since 1916, the following Table has been designed to show the outstanding results obtained:—

Comparison of crop from Manitoba Flint Corn in 1916 with crop produced in 1921. Both were good years for corn.

Table 1.

Particulars	Crop 1916	Crop 1921	Increased Crop 1921 over 1916
	lb.	lb.	lb.
Total yield of ears per acre, Weighed in field before storing,	5,511	6,282	771
Mature ears: yield per acre, Weighed in field before storing	4,691	5,717	1,026
	per cent	per cent	gain per cent
Average percentage maturity	85	91	6
Number of days to mature from date of planting to date of husking.	107	102	5

From the above Table, it will be seen that in total weight of ears the 1921 crop exceeds that of 1916 by 771 pounds which represents an increase of over 12 per cent. This increase alone is quite appreciable: but,

FIG. 2.—NORTH WESTERN DENT CORN (growing crop) Seed planted May 29. Crop mature on Sept. 10, 105 days. Average height below tassel 67 inches.

when we consider this in conjunction with the advanced maturity, we find that in addition to the 12 per cent increase in the total weight of the crop for 1921 the percentage maturity is also increased by six per cent.

Further, in considering the number of days taken to obtain the above results, we find that in 1921 it took five days shorter time to mature the crop than was required in 1916. A comparison of 1916 results with the results for 1921 may be briefly stated thus:—In 1921, the total crop of ear corn was increased by 771 pounds; the maturity was increased by 6 per cent; and the time taken to grow and ripen the crop was reduced by five days.

Selection Work with Northwestern Dent

This is a variety of corn which has been extensively grown in North Dakota and Montana and is also very much in favor in Manitoba for producing fodder corn. North-western Dent is a semi-Dent type. The cob is white, but the kernels are red with a white or yellowish-white tip. It yields a good weight of fodder, matures fairly early, and usually produces more suckers than any other Dent or semi-Dent variety in cultivation. (Figs. 2. 2a.).

In 1917, it was decided to begin selection work with the North-western Dent, and, for this purpose, seed was obtained from a local seed company.

At this station, the seasons of 1917-18 were decidedly unfavorable for corn; but in 1918, partially-matured ears were selected and planted in 1919. This was a good corn year and was our first year of real success in producing a well-matured crop of North-western Dent.

The ears from this crop—though well matured—were very variable in size and color, and the number of rows per ear ranged up as high as twenty. Some ears were found to have kernels of a distinctly Flint character, and ears having this type of kernel were usually

FIG 2a—CORN: North-western Dent; crop of husked ears grown from single rows, 22 yards long.

better matured and the grain had more lustre than had that of the Dent type.

The chief points observed in the selection of seed were well-matured, medium-sized ears having twelve rows,

During the past two years, some attention has been paid to size and character of the plants in the field, and the selection methods as previously described have been practised.

The selection work in this variety has resulted in a strain in which the twelve-rowed ear is predominant, and the average time to mature the crop from planting to harvesting is now about 105 days. During the progress of the work, it has been noticed that the kernel is gradually losing its Dent character. This change is being brought about owing to the early-maturing Flint type of ear being selected in preference to the later-maturing ears of the Dent type.

Table 2 showing comparison of the total yields of North-western Dent and Manitoba Flint. (weights per acre).

Crop, 1921.

Variety	Number of days to mature	Total weight of ears	Weight of total crop: stems and ears.
		lb per ac.	lb. per ac.
Manitoba Flint	102	6,282	21,120*
North-western Dent	105	6,310	29,383

*This crop was somewhat damaged by straying cattle, and the total weight is rather below the true yield of the crop.

From the results shown in the above table, it would seem that, in a good corn year like

FIG. 3.
Sample crop of corn hybrids, first generation from cross, II. North-western Dent (N.W.D) used as male parent.

Female parent.	Male parent.	Female parent.	Male parent.
I Squaw Flint	x N. W. D.	V King Philip	x N. W. D.
III Longfellow	x N. W. D.	VI Minnesota 23	x N. W. D.
IV Manitoba Flint	x N. W. D.	VII Minnesota 13	x N. W. D.

Yield of ears shown from rows, 22 yards long.

the season of 1921, the total yield of ears is rather greater in the Northwestern Dent than in Manitoba Flint; while the total weight of crop is decidedly in favor of the Northwestern Dent. It will also be seen that in 1921 there was not a very wide difference in the time taken to mature the two varieties. It should be pointed out, however, that it is in a poor corn year that early-ripening properties of Manitoba Flint are most strikingly brought out: in a good season, the later-maturing sorts usually give a good account of themselves and may frequently outyield (even in production of ear corn) smaller and earlier-maturing varieties.

Crop Yields from Cross-bred Seed Corn.

It has long been recognized by breeders of beef cattle that, if animals from certain carefully selected beef breeds be intercrossed, the progeny from the cross will develop more rapidly and generally produce more beef in a given time than the progeny from either breed when pure-bred.

Plant breeders are well aware that the same general principle holds good in plant life. Various investigators have shown conclusively that the progeny of the first cross from certain selected strains of corn will produce a crop greatly in excess of either of the parent strains when they are grown as pure-bred crops. Still, it should be kept in mind that cross-bred plants obtained in a haphazard fashion will not necessarily be superior to either parent. If parents are not carefully selected, the progeny from the cross may prove to be inferior to either of the parental forms. (1) (2.) (3.) (4.) (6.).

In order to test the fodder-producing capacity of crossbred seed-corn as compared with average pure-bred parents, experiments were commenced in 1919. It was decided to use Northwestern Dent as the male parent and to cross this with six other well-known varieties, including Manitoba Flint, Longfellow, King Philip, Squaw Flint, Minnesota 23, Minnesota 13. The project was

FIG 4.—Simple methods of storing corn, crop 1921—I. North-western Dent in strings. II—Manitoba Flint on corn trees (A) and on nailed boards (B).

worked out in the field in the following manner:

The above-named varieties were planted in rows, each variety alternating with a row planted with North-western Dent. As the tassels appeared in the six varieties, they were carefully removed; but the tassels of the North-western Dent were allowed to develop and produce pollen which was carried by the wind and deposited on its own silks and also on the silks of the six varieties planted in adjoining rows. Thus, from the rows planted with North-western Dent, purebred seed of this variety was obtained; while the other rows produced seed which was crossbred between the respective varieties and North-western Dent.

In the following year, 1920, the cross-bred seed from the six varieties was planted in alternate rows with North-western Dent, and the total crop yields obtained from the respective rows. The results showed that in every case the cross-bred seed gave a greater total yield than the pure North-western Dent; but, as most of the cross-bred crops were not so well matured, the fodder was of inferior quality. One of the cross-bred crops, however, produced a greater yield of fodder and was better matured than the North-western Dent: this was the crop from the cross between Manitoba Flint and North-western Dent. (Fig. 3).

In the accompanying table, there will be found the summarized results setting forth the crops produced by Manitoba Flint and North-western Dent respectively; also the crop produced from the cross-bred seed obtained from the crossing of these two selected varieties.

Table 3

Shows comparative yields per acre of Manitoba Flint and North-western Dent when grown as pure crops and also when intercrossed and a crop raised from cross-bred seed.

Years 1920-21.

	i	ii	iii	iv	v	vi
Variety of Corn.	Crop year	Number of days for crop to mature	Total weight of ears (per acre)	Average weight of ears 1920-21. (per acre)	Weight of total crop 1920-21. (per acre)	Average Weight of total crop 1920-21. (per acre)
		days	lb.	lb.	lb.	lb.
Manitoba Flint	1920	102	3,872	5,077	21,120	
	1921	102	6,282			
North-western Dent	1920	106	3,960	5,135	18,502	23,942
	1921	105	6,310		29,383	
Manitoba Flint (female) x North-western Dent (male) cross-bred seed.	1920	106	5,060	6,352	21,230	28,737
	1921	105	7,645		36,245	
Increase in cross-bred crop over North-Western Dent, Average for 1920-21.				1,217		4,795

* Not estimated in 1920.

The above table (column iv) shows that in 1920-21 the average weights of ear corn produced by the seed from the two selected parents do not differ very greatly; whereas the cross-bred seed gives 1,217 pounds greater yield than is produced by the slower-maturing parent, North-western Dent.

In considering the average total yield as stated in col. vi, it will be seen that for the past two years cross-bred seed has given an average increase of 4,795 pounds over the heavier-yielding parent, North-western Dent.

These increases in crop yields are quite appreciable and show in a marked manner the superior crop-producing properties of suitable cross-bred seed as compared with seed from a single selected strain.

As regards the advisability of adopting this system of producing and using cross-bred seed corn in general farm practice, it will be necessary to continue experiments under varied soil conditions and over a series of years before reliable recommendations can be made.

Corn Breeding Work in Progress.

From the explanations given above, it will be seen that in these trials on corn hybrids for fodder the superiority of the cross between Manitoba Flint and North-western Dent is very noticeable.

The question may naturally arise as to whether it might be possible to fix the superior cropping properties of this cross-bred, and thus produce a new improved breed of corn. With the object of testing this question it was decided to follow up the work.

Having in mind the superior cropping powers of North-western Dent, the first step was to take the first generation cross between the Manitoba Flint and North-western Dent and back-cross with pollen from the Dent, thus producing cross-bred seed having a double dose of the Dent parent. This back-cross (or sesqui-hybrid) was made for the purpose of bringing more of the superior, dominant size characters of the Dent into the second generation of the cross-bred.

Last season (1921), seed from this back-cross was planted and, from selected plants, self-fertilized seed was obtained. Our work with this back crossed seed is still in progress, and it remains yet to be seen whether we shall be able to produce a variety of corn which will reproduce truly those superior characteristics we are striving to perpetuate.

SUMMARY.

1. At this station well-ripened seed corn has been produced in five of the past seven seasons ended 1922.

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2. Preliminary comparative tests indicate that Manitoba grown seed corn may be better suited to local conditions, than that obtained from a warmer climate with a longer growing season.

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3. By judicious selection from suitable well-known varieties of corn, strains may be isolated which mature in a decidedly shorter time than was formerly taken to mature the original stock from which the selections were first made.

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4. First generation hybrid seed corn obtained from a suitable cross between a small early variety, and a larger later variety, gave a total crop yield of 4795 pounds, per acre, greater than the crop produced by seed from the larger parent.

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Stock Raising Problems of the Interior Sections of British Columbia.

BY GEO. C. HAY

Kamloops, B.C.

(Paper read before British Columbia Branch of C.S.T.A., April, 1922.)

In presenting this paper an attempt will be made to lay before you some of the more important problems that are confronting the stockmen of the inland sections of the Province of British Columbia. Some of the problems presented will no doubt be of concern to the whole of the Province, but the purpose of the paper is to deal more especially with matters concerning the ranchers and farmers in the range sections, particularly the Nicola, Cariboo and Kamloops districts.

Before proceeding with the subject matter, it will be necessary to review briefly the development of the live stock industry in the interior since the transformation that has taken place during the past quarter of a century is the cause of some of the more important problems facing stockmen today.

The first record that we have of the introduction of beef cattle into British Columbia was in the early forties, when consignments were brought to the southern end of Vancouver Island by the Hudson's Bay Company from their farm in what is now Washington State.

In the sixties, during the time of the gold excitement on the Fraser river and in the Cariboo, a number of cattle were driven into British Columbia from Oregon, Washington, and California for supplying beef to the miners. About this time several small herds were established in what are known as the cattle range districts of the interior of the province. Under favorable climate conditions and with an abundance of feed, these herds increased rapidly and their surplus animals soon made a reputation for British Columbia bunch-grass beef. Practically no winter feeding was done in those days, and instead of providing hay, the lower benches were kept ungrazed for winter feeding. In the growing season the herds were driven to higher elevation as the vegetation started to grow. In this way the winter, summer and fall ranges were widely separated, and broad areas were covered in a year's grazing. In those days cattle men could pick and choose their ranges according to the season. Now, owing to closer settlement, they cannot.

Placer mining strikes at different points in the interior from time to time during these pioneer days provided the ranch men with a good market while the excitement lasted, and some of them who are now very comfortably situated, can trace the beginning of their prosperity to the market created by those early-day mining camps.

The building of the Canadian Pacific Railway and the gradual slackening up of placer mining entirely changed the market situation. The ranchers then began to look to the Coast cities for a market for their meats, and their stock was driven to Ashcroft (the gateway to the Cariboo) and there loaded on the cars for shipment. Such is but a brief outline of the commencement of cattle ranching in the Interior of British Columbia which today remains practically the only great cattle ranching country in Canada.

About thirty years ago the whole of the interior of the Province was devoted to cattle and sheep ranching, but the influx of settlers has converted a great many of the ranches near the railway into small holdings where alfalfa, beans and potatoes, as well as a little grain, are being grown, and a few head of stock are kept. However, the real ranching districts of British Columbia are in the Nicola Valley, south west from Kamloops, and in the Chilcotin, which lies north of the C. P. R., and is reached by the Cariboo road running north from Ashcroft.

We therefore see that the transformation of the industry through the settling up of the country presents two problems, namely, summer feeding and winter feeding of stock. First, let us deal with summer feeding. The days of the waving bunch grass ranges are gone, for a few years in any case, and in their place we have ranges almost

void of vegetation. The principal cause of the prevailing conditions, no doubt, is due to the invasion of the settlers in the range districts, and the consequent reduction of the grazing areas, without proportionately reducing the number of range cattle. In addition to the ranges being overstocked with cattle, in recent years they have also been over-run by a plague of grasshoppers. During the past three seasons, grasshoppers have been a serious menace to the range areas of this province; altogether the depletion of the summer ranges presents an important problem to the stockmen. The matter is being dealt with by the Provincial Grazing Commissioner who works with the stockmen in an endeavour to limit the number of cattle on the more depleted ranges, as well as seeking new grazing areas. Re-seeding experiments are also being conducted. Furthermore the Entomological Department is studying the grasshopper situation, in the hope of being able to assist in measures of control.

Following summer feeding and equally important is winter feeding. In the early days when the ranges were good, and beef was comparatively cheap, little provision was made in the way of putting up feed for winter. The lower ranges were preserved during the summer, and only during the most severe weather was it necessary to feed. Of late years cattle have been more valuable, and consequently more attention has been paid to bringing them through the winters in better shape. The usual practice is to provide a ton of hay per head. The amount of hay per head of course varies in accordance with the amount and condition of the winter range, and the owner's ideas regarding winter feeding. Where irrigation is possible, alfalfa is found to be the best crop to grow. On the higher lands where dry-farming has to be practiced, the production of winter feed is a bigger problem. Oats, barley, rye and wheat are all used as grain hay; sunflowers are grown very sparingly as yet. It would appear as if some experimental work in the way of proving the adaptability of certain grasses for hay in the dry-farming sections of this Province would be helpful to the stockmen in solving the problem of winter feeding.

With the transformation of the industry, bringing about the problems of summer and winter feeding, brings also a realization that it is economically advisable to maintain as superior a type of cattle as possible. Hence the desire to improve by better breeding methods the existing range herds. A growing desire is noticeable on the part of stockmen to secure pure bred bulls of good beef type to replace the grade and scrub bulls of which far too many at present are being used. This line of action involves considerable expense and inconvenience to the rancher. but with the increasing over-head expenses in the way of increased land values, increased taxes, high operating expenses, the ultimate value of the procedure is not denied. We therefore find many of the farmers and small ranchers replacing their mediocre cattle by pure bred heads of the beef breeds. With a growing demand for good pure bred beef bulls on the range, a market is assured the breeder who establishes himself along proper lines. The problem at present is to afford an oportunity for the rancher to secure superior quality bulls, economically, as well as afford an opportunity to the farmer and small rancher to economically establish himself in the pure bred business. The British Columbia Stock Breeders Association through the medium of the Kamloops Bull Sale provides this opportunity. Prior to establishing this sale in 1919, stockmen desiring pure bred bulls had to go outside the Province to secure them, which involved untold expense, and only those in good financial circumstances were able to afford it. The Kamloops Sale eliminates much of this expense, in that there is assembled annually at a convenient point within the Province, namely Kamloops, a collection of superior pure bred beef animals, male and female, which are sold by public auction to the highest bidder. The noticeable result is the increasing use of pure bred bulls on the range, and the gradual elimination of the scrub, and at the same time, the establishment of pure bred beef herds within the Province.

Perhaps the most important problem confronting the interior stockmen today is that of marketing. At least this has been the question most uppermost in the minds of stockmen during the past year. Previously less consideration was given this phase of the business, in that prices were good, and

a more or less prosperous independence reigned among stockmen.

They had no difficulty in disposing of their beef at unusually high prices and consequently took little thought of the market, but rather let the market take care of itself, which it did do very satisfactorily until about two years ago, when prices started to slide downwards. Many of the ranchers were slow to sell, believing that the break in prices would be only temporary, and few if any thought it would go to where it did this fall when many cattle were sold for less than it cost for the previous winter's feed. It was during this falling market that the buyers exercised close discrimination against inferior and poorly finished cattle. Such cattle were found most difficult to sell at any price and it is on this point that buyers and producers frequently differ. It is frequently stated, by the producers more particularly, that buyers in this Province have but one price for beef, regardless of quality and finish. This is not correct, as parties with good well-finished beef do receive a better price for same. However, exception can be justly taken of the fact in connection with B. C. marketing conditions that the prevailing situation allows the buyer complete authority to dictate the price and grade of the seller's cattle. The prevailing market conditions in British Columbia permit this fact, in that there are no public stockyards in the Province operating under the Dominion Stockyards Act, to which cattle can be consigned and graded by an independent government grader, before being offered for sale. In short what the interior stockmen resent, and are anxious to have rectified is being at the mercy of two packers, who do very little competitive buying.

Whether the establishing of public stockyards at a convenient point within the Province would be sufficient to even help solve the marketing problems is not definitely certain. Whether the packers would welcome the idea of public stockyards and by such eliminate the drover's expense in collecting cattle all over the province seems uncertain. Whether in the event of the packers not co-operating with the producers in the way of purchasing through public stockyards, once they were established, it would be necessary to undertake the erection of a cold storage and packing establishment of their own is a consideration. These are all questions running through the minds of stockmen, but to date no one seems to have a remedy for the existing state of affairs. However it would appear that since the marketing of live stock and farm produce is an interprovincial matter, and comes under the supervision of the Dominion Department of Agriculture, this problem should be referred to them for attention. It would also seem that in referring this matter to the Dominion Department of Agriculture in the form of a request for a thorough investigation of B. C. live stock marketing conditions, it would not be asking more than the Province is justly entitled to, particularly since practically every other province in Canada is equipped with public stock yards, and a staff of Dominion Government officials looking after live stock marketing affairs. A thorough investigation no doubt would decide the desirability for stockyards and the most feasible way of establishing same.

In conclusion let me state that a brief attempt has been made to point out that the gradual settling up of the country, without proportionately reducing the number of range cattle has brought about the problems of summer and winter feeding, both of which are being studied and taken care of. It has also been shown that owing to the increased cost of producing beef, and the discrimination on the market against inferior stuff, a desire has been created on the part of stockmen to raise a superior class of cattle. In this connection, the Kamloops Bull Sale offers an opportunity of obtaining high class breeding animals. Lastly, the prevailing live stock market conditions are very unsatisfactory to the producer, and an investigation is suggested in the hope of improvement.

Economic Field Problems relating to Horticulture.

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(Paper read before British Columbia Branch of C. S. T. A., April, 1922).

From a horticultural standpoint the problems of today are in many instances similar to those that have been experienced in other fruit growing provinces for a number of years and they were dealt with, or an attempt was made at dealing with them, long before it was necessary to consider them in British Columbia. But as the production of fruit in this province increases and the areas devoted to fruit growing become more intensive the problems which we have to face resemble in a good many cases the problems which older fruit growing sections have had to face and are still facing.

In this paper the horticultural field problems are therefore divided into the following classes:—

(1) Soil Problems.
  (a) Rotation of Crops.
  (b) Cover Crops.
  (c) Commercial Fertilizer Problems.

(2) Variety Problems.

(3) Pest Control Problems.
  (a) A knowledge of Life Histories.
  (b) More effective sprays.
  (c) A knowledge of spray machinery.

(4) Storage, Precooling and Shipping Problems.
  (a) Temperatures.
  (b) Moisture.
  (c) Length of precooling.
  (d) Most suitable temperature of cars.

Soil Problems.

With the increasing demands that are being made on our soils by the trees in our orchard areas that are coming into bearing or that are already in bearing, it is becoming evident that work must be done towards supplying the demand for required plant food. Not only is this evident in our orchard areas but it is apparent also in the areas devoted largely to small fruit. The questions naturally arise, how is this supply to be secured and what are the most economical means of supplying this demand? Many of our soils, in fact most of them, were cleared, or if not cleared, as we look upon that word, were changed in a very short time from raw land to high-priced land presumably suitable for orchard purposes. Following planting in many cases, clean cultivation has been practised year after year with the result that the humus has been burnt out of the soil, making it impervious to water, as well as diminishing the quantity of plant food present. A change is necessary. Not only must the physical condition of the soil be improved but the supply of plant food increased. How is this to be done? The improvement of the physical condition may be done by the use of cover crops and preferably leguminous cover crops. Addition to the soil of these kinds of crops will also assist in improving the supply of plant food, not only directly but indirectly. However, as stated before, many of our soils are deficient in plant food and a direct supply is necessary. This may be secured by the application of chemical fertilizers in one form or another and while the men who are engaged in field work can as a rule ascertain whether or not a soil would be benefited by the use of cover crops for the sake of humus, they are not in a position to state definitely what the exact chemical requirements of a soil may be. The field man can draw up a schedule of experiments for chemical fertilizers, but as for making definite recommendations in this line of work it is impossible. Soils on each ranch differ and it is necessary for the grower to ascertain for himself the requirements of his soil. In order that he may be assisted in this matter with regard to quantities, combinations, etc., the Demonstration Plot will prove

of assistance, not only for chemical fertilizers but for cover crops as well.

Moisture and its supply is another feature of horticultural work that is closely allied with soil work. Little has been done along this line, but it is one of the most important problems with which we, as horticulturists, have to deal. A sufficient supply of moisture is necessary to insure plant growth as well as to give us the quality of water required and also the best means of taking full advantage of the water which is at present obtainable, whether it is by means of clean cultivation or by the use of cover crops.

Variety Problems.

As in any other fruit growing section, this province has its full share of difficulties in trying to ascertain the varieties of both small and tree fruits suitable to the various localities. This is of course to be expected in a country that from a fruit growing standpoint is comparatively young. At the present time however, certain varieties are being eliminated and we are reaching the position where we are better able to advise growers as to varieties suitable to their district. New varieties will have to undergo the test, not only of the experimental stations but of the individual grower. This is a matter however, which is not at all serious except that while it is advisable to try out certain of the new variety productions, the grower is to be cautioned against the abandoning of old and tried varieties until he is sure that his soil and other conditions are suited to a new variety, no matter how well it has done in another locality.

Fruit Insects and Diseases.

This follows the other two points that have just been mentioned. The control of fruit insects and diseases constitutes one of the most important problems which we have to face today. Knowledge of life histories is important. Work along this line is being carried out with the most important pests, the horticultural field men securing this information from the entomologists in charge and disseminating it amongst the growers. Thanks to the men of the entomological and plant pathology divisions the field man is in a position to advocate control measures for most of our fruit insects and diseases. Constantly however, new insects and new diseases are making their appearance and their control presents a continual problem. From an economic standpoint also the most suitable spray to be used in each case has to be considered. Recommendations are continually changing as more adequate methods of control (either in sprays, methods or time of spraying) are evolved. Another point that has also to be considered is the best and most efficient way to place the spray on the trees, whether the use of spreaders is necessary and what type of spray machine will give the best service at the minimum cost. The efficiency and economy of sprays and spraying methods should always be well considered before recommendations are made.

Storage, Precooling and Shipping Problems.

With regard to these points it is necessary to point out briefly lines of work that might be attempted. From a storage standpoint it is likely that in the near future work will be carried out at our experimental stations which will give shippers and buyers a great deal of information regarding the most suitable temperature as well as the most satisfactory moisture conditions for a storage chamber. Work might also be done as to these conditions on different varieties at various stages of maturity, assisting not only in selling the fruit crop but possibly also in checking the breaking down of various fruits.

Work also remains to be done in our small fruit shipping areas. The grower of today, shipping in carload lots, finds that his fruit will carry better if it has the advantage of precooling even though iced cars are used. What is the best method of precooling? What temperatures are the most satisfactory for both storage and cars, and how long can fruit be held commercially at different temperatures? This perhaps may not be considered a field problem in the strict sense of the word, but it is closely allied. The field man of today is the man on whom the grower depends for his information. His office is the clearing house for fruit growing information no matter what branch it may be, and he in turn is dependent upon the investigator in all lines of horticultural work. Let us hope that his services will be more appreciated by all classes in the future than they have been in the past.

Sechage des Plantes pour Herbiers.

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L'herborisation est un des plus innocents et des plus instructifs passe-temps. L'herbier qui résume au botaniste ses excursions est un de plus précieux souvenirs. Mais quel effort d'imagination il demande, cet herbier, quand il vous montre ses plantes fanées, écrasées, cassantes, décolorées, méconnaissables! Qu'est devenue la poésie des champs dans ce grand cahier dont chaque feuille porte le cadavre d'une fleur? Si vous n'avez collectionné que pour identifier et cataloguer, vous trouverez encore de l'utilité à tourner ses pages; mais si vous avez travaillé pour admirer et jouir, quelle déception! Aussi on comprend les efforts tentés pour garder aux plantes séchées une partie de leur beauté naturelle. Je me propose d'étudier brièvement cette intéressante question.

I.—Divers procedés.

On peut réduire à trois les procédés employés pour sécher les plantes des herbiers: le procédé compliqué, le procédé commun, le procédé que j'appelle intermédiaire.

Le procédé commun consiste à mettre les plantes entre des feuilles de papier hydrophile qu'on presse fortement. Si la presse fait défaut, on la remplace par des pierres ou des briques! Rien de plus simple; mais aussi rien de plus fastidieux que de changer le papier pour activer l'opération, et empêcher la fermentation; rien de plus pitoyable que le résultat: plus de couleurs, plus de charmes!

Les procédés compliqués exigent de savantes manipulations et reposent sur des théories, vraies ou probables, qu'on ne peut pas imposer à un botaniste amateur ni même à un spécialiste qui s'est limité à la taxonomie et à l'anatomie des plantes sans approfondir les lois physico-chimiques qui règlent leur fonctions.

Le procédé intermédiaire unit la simplicité à la rapidité, tout en donnant des résultats parfois merveilleux, toujours supérieurs à ceux du procédé commun. Sa vulgarisation est donc à souhaiter. C'est ce procédé intermédiaire que je voudrais brièvement discuter en m'appuyant sur une expérimentation scrupuleusement contrôlée et sur les réactions physico-chimiques les mieux connues.

A. Principe du procédé intermédiaire.

Depuis quelques années les compagnies ont mis en vente un outillage très varié, chaque maison prônant ses produits. Tout botaniste peut construire son *indispensable* qui est fort restreint. Le principe qui sert de base est le suivant: "sécher rapidement et à une température supérieure à la température ordinaire". Je fais abstraction des exceptions qui sont rares. En activant l'évaporation on supprime ou du moins on atténue très notablement les réactions chimiques nombreuses qui se continuent dans la plante séparée de sa racine et dont beaucoup atteignent directement la coloration. En élevant la température on modifie les conditions qui permettent aux ferments figurés et aux diastases de réagir.

Tel est le principe. Mais la théorie aussi bien que l'expérience nous imposent des limites. Pour la rapidité, en tant qu'elle n'atteint que l'évaporation, aucune difficulté: peu importe, si l'eau doit partir, qu'elle parte vite ou non. Si son absence même doit décolorer la plante, ce qui est assez fréquent, il faut s'y résigner. On peut parfois obvier et remplacer l'eau, mais par des réactifs chimiques. La rapidité n'a donc pas d'inconvénient, tandis qu'elle a l'avantage de diminuer le temps d'action des éléments nuisibles.

On n'en peut dire autant de la température. La température ordinaire n'est pas nécessairement la plus favorable aux ferments; en l'élevant on peut donc atteindre une zone nuisible à la plante. Cette zone est comprise entre 5° et 42°C., avec maximum d'activité diastasique vers 35°. Il faut surtout éviter la température 25°-35°C. Au-dessus de 60° C. la fermentation est pratiquement paralysée: le *Bacillus subtilis*, commun partout et résistant à une température beaucoup plus haute ne me paraît pas avoir d'action appréciable dans la fermentation atteignant les

couleurs. On peut donc éluder les difficultés en portant d'abord la température à 60°-70° C., puis en la baissant rapidement, soit au-dessous de 35°, soit près de 45°. Pourquoi ne pas maintenir une température élevée pendant toute la durée du séchage, disons 70° ou 80° C.? Parce que cette température favorise certaines réactions chimiques, notamment des éthérifications et des saponifications, tant que l'eau est présente en quantité appréciable; et puis, les plantes séchées à une température élevée sont plus cassantes; pour les plantes aromatiques s'ajoute le fait que la plupart des essences à odeur agréable sont trés volatiles au-dessus de 50° C.

B. Appareil à sécher.

La rapidité et la chaleur peuvent être obtenues de bien des manières; aussi la botaniste peut-il s'ingénier dans la construction de son appareil. Cependant il convient de rappeler que si la température peut activer l'évaporation, elle n'est pas seule à donner ce résultat; la circulation de l'air ou ventilation joue un rôle important: c'est même le grand avantage que cette méthode possède sur l'ancienne où l'air n'était pas admis. Tout revient donc à ventiler activement en variant la température à volonté. En pratique il faut distinguer deux cas, suivant que l'on veut ou non garder à la plante sa forme naturelle.

Si l'on excepte les grands musées, les planets sont rarement conservées avec leur forme naturelle, parce qu'elles occupent trop de place, d'autant plus qu'elles doivent être gardées à l'abri de l'air pour retenir leur fraîcheur. Du reste leur préparation exige alors des manipulations compliquées et sort du cadre de cette étude. Supposons que le botaniste consente à voir ses plantes un peu aplaties. Comment doit-il procéder?

Les placer délicatement sur de la ouate, entre deux feuilles de papier hydrophile. On peut en emplir un nombre indéfini. Entre chaque rangée intercaler une feuille de carton gaufré en rides paralléles. Mettre le paquet entre deux planches qu'on pourra serrer modérément par une ou deux courroies. Pour le séchage on utilise la chaleur d'un calorifère, d'un tuyau de poêle, etc. Pour préciser les idées, supposons qu'on dispose d'ampoules électriques ou d'un petit rhéostat. Placer la source calorifique au fond d'une caisse percée de petits trous pour l'entrée de l'air à la partie inférieure. Mettre le paquet de plantes au-dessus de la boîte, à la place du couvercle, de façon que l'air ne puisse s'échapper que par les minuscules canaux du carton gaufré. On voit que le séchage peut être aussi rapide qu'on veut; il suffit de modifier l'entrée de l'air, sa sortie, la quantité de chaleur, la hauteur de la boîte qui fonctionne comme cheminée. La source calorifique doit être disposé de façon que l'air puisse entrer et sortir uniformément aux diverses endroits. Ainsi, avec une seule lampe au milieu d'une grande boîte, l'air sortirait surtout par un espace rsetreint, au-dessus de la lampe; les extrémités du paquet sècheraient beaucoup plus difficilement. Du reste il suffit de voir le mécanisme pour y remédier au besoin: l'eau absorbée par le papier hydrophile est entraînée par l'air chaud et rapide qui monte dans les canaux du carton gaufré. En quelques heures on sèche les plantes ordinaires en aussi grand nombre qu'on veut; celles qui contiennent beaucoup d'eau peuvent la livrer toute en une nuit. Les frais de chaleur artificielle, qui sont nuls si on utilise la chaleur perdue d'un poêle de cuisine.... sont contre-balancés par l'économie du temps qu'exigeait le renouvellement du papier buvard dans l'ancien procédé. Si la cueillette est abondante, on sèche au fur et à mesure, le même jour, sans accumuler le papier hydrophile pendant une semaine: 300 échantillons préparés le soir seront secs le lendemain matin. Quand même ce procédé n'aurait pas d'autre avantage, il devrait supplanter l'ancien. Si on est en vacances, dans un camp...., un petit foyer ou une lampe à pétrole peut fournir la chaleur; la caisse peutêtre remplacée par des bandes de toile cirée fixée sur quatre bâtons.

C. Détails pratiques.

Beaucoup de plantes se décolorent à la lumière; la raison est loin d'être toujours obvie; elle est souvent hypothétique: en tous cas l'expérience montre que les couleurs se conservent mieux si le séchage se fait dans l'obscurité. Cette constatation est à retenir quand on veut laisser aux plantes leur forme naturelle; pour les autres cas, le papier qui

rase plus ou moins voile suffisamment la mière.

Ne pas attendre que la fleur soit trop eille; la cueillir, avant la complète flo- ison: les sépales et les pétales ont plus d'ad- érence, et les réactions qui amènent la dé- oloration après fécondation n'ayant pas en- ore commencé' les teintes restent plus vives. oujours préférer un temps sec à un temps luvieux: qu'il n'y ait pas d'autres eau à vaporer que celle de l'intérieur des tissus. l est avantageux pour beaucoup de plantes 'absorber de l'eau pendant 20 à 24 heures près la coupe, dans une chambre chaude; vant le séchage, enlever l'extrémité de la ge qui trempait dans l'eau.

On peut activer la dessiccation et obtenir ne plus grande stabilité des couleurs en rempant préalablement la plante dans un nélange d'une partie d'acide chlorhydrique t 550 à 600 parties d'alcool. Si l'alcool est bsolu, on a une dessiccation presque instan- anée dans un courant d'air; il est à peine nécessaire de recourir aux presses avec les lantes ordinaires. Ce procédé peu économi- que n'est pas applicable à tous les cas: la réaction de l'acide ou de l'alcool avec des orps intérieurs instables détermine parfois les altérations notables des teintes, spéciale- nent avec des fleurs rouges qui deviennent osées.

Les plantes fragiles comme les Nénuphars, es Iris, l'Arum, peuvent être solidifiées par e procédé suivant: les tremper dans une olution de gélatine, puis dans une solution le formol: la gélatine, durcie et insolubili- ée par le formol, soutient la plante.

Les plantes séchées par une température levée et cassantes peuvent être améliorées t recouvrir leur souplesse et la délicatesse le leurs teintes par immersion dans un bain le glycérine et d'alcool auquel on ajoute un peu de carbonate de cuivre. Si on veut em- pêcher la fermentation ultérieure, il suffit d'ajouter de l'acide salicylique au bain pré- cédent. Cependant, je préfère une opération séparée pour atteindre ce but: elle consiste à tremper la fleur dans une solution alcoolique de bichlorue de mercure (sublimé corrosif). Eviter de toucher les plantes ainsi aseptisées. Leur conservation est indéfinie.

Les visiteurs des musées du Caire ont parlé de fleurs trouvées dans les tombeaux construits du temps des Pharaons: il ont cité des Chrysanthèmes, des Pavots, des Lotus parfaitement conservés depuis tant de siècles! La peine que nous nous donnons aujourd'hui malgré les progrès modernes nous rend un peu sceptiques pour ces merveilles. Nos plus belles plantes, quel que soit le procédé employé pour les sécher, se flétrissent toujours un peu. L'absorption de l'air en est la cause principale. On peut les protéger en les isolant par une feuille de papier cellulöide colée avec soin sur l'herbier rendu lui-même imperméable par un vernis. Si la fleur a sa forme naturelle et ne doit pas être aplatie, on la garde dans un flacon bien bouché au fond duquel est un peu de chlorure de calcium.

Une dernière remarque: j'ai parlé de ouate sur laquelle seraient étendues les plantes; le but est de conserver mieux la forme, tout en absorbant rapidement l'eau qui es tensuite cédée au papier hydrophile. Malheureusement la ouate s'attache à certaines plantes avec une ténacité telle qu'il faut l'arracher poil par poil. C'est le cas par exemple pour l'Orme, la Julienne, le Cèdre, la Linnée .. . Ce qui est plus grave, c'est qu'on peut rarement prévoir cette adhérence; elle n'est pas en rapport avec la rugosité des feuilles ou avec d'autres caractères visibles. Sans être très commune, cette adhérence existe chez un dixième environ de nos plantes. Si on ne met de la ouate que sur le côté de la plante qui reposera sur l'herbier, les conséquences ont peu d'importance; si on met de la ouate de deux côtés, il faut s'exercer à la patience ou sécher un autre échantillon!

(à suivre)

Rocks as Fertilizers.

Contributed by the Department of Colonization and Development of the C. P. R.

Canadian farmers must realize that they cannot go on forever taking food values—nitrogenous and other constituents—out of the soil and standing even greater loss by leaching. Soils become worn out like anything else unless the greatest care is taken to keep them in good repair, and like a great many people when they become worn out they turn sour. Farmers in the Dominion may say this time is a long way off, but this is not so, as agriculturists in the older farming sections of Ontario, Quebec, and the Maritime Provinces can tell. Even in the newer areas farming is inevitably tending in that direction and only the timely application of a remedy will head off the disastrous end.

There is a sort of very slow effervescence in the soil that is nurturing life and unless something is placed back to supply the salts or the limes taken out of the soil the acid part is in too great an abundance, life is not ministered to, and the result is barrenness. The most direct way to correct acidity in the soil is to apply lime. This has been known and acted upon for several centuries. Lime and the surplus acids of the soil are enemies, the one fights against the other and the former possibilities of soil production are brought about.

And for the average Canadian farmer the remedy is easily procurable and applied. It is not necessary to buy land-plaster, quick lime, or slacked lime as was the old practice. On most soils, especially on light land, actual limestone, crushed small, gives better results than the lime and its effects remain longer with the soil. It sounds strange at first to suggest broadcasting small stones upon meadows or harrowing them in on grain fiel but it is sensible when one comes to think it. The acids in the soil decompose the lit stones slowly, as its needs call for them. T method has been proven by long experien to work excellently. Usually it is found th the smaller the stone the speedier the resu from the soil and there is little fear of app ing too much limestone to the land, from t to ten tons per acre according to the acidi of the soil being recommended.

For soils low in organic matter the crush stone is especially well adapted. On meado and pasture lands the stone is simply spre on the surface at any convenient season of t year. One effect of this is soon notice namely, the increase and strength in bone a tissue of cattle and horses fed on or from la so treated. This is natural enough sin lime is a main constituent of bone. On gra land the crushed stone is spread common by shovel from a wagon and lightly harro ed, not ploughed, in.

The great inducement to farmers to so e rich their lands and maintain them in the present state of high productivity is the lo price of bringing this about. Limesto quarries are to be found in the vicinity practically any settled farm district and t rock can be brought to the land at a ve low cost. Quotations from a quarry speciali ing in such stone in the vicinity of Montre shows that by the carload it could be load f.o.b. at the quarry for $1.60 to $1.80 p ton. Certainly such application will in appreciable time return many fold the e pense of purchase and labor entailed, in b ter crops and livestock.

NOTES.

In the last issue we referred to M. A. Jull as being a graduate of the O.A.C. in 1918. This should have been 1908.

A meeting of the C.S.T.A. Executive Council was held in Toronto on November 23rd. Those present were President J. B. Reynolds, H. Barton, Jules Simard, L. H. Newman, Arthur Gibson, J. A. Clark and F. H. Grindley.

V. B. Durling (Macdonald '15) formerly at the Entomological Laboratory, Annapo is Royal, N. S., is now assisting Geor Sanders (O.A.C. '07) at the Deloro Chemic Company, Deloro, Ont., in the manufactu of insecticides, fungicides and weed kille

L. C. McOuat (Macdonald '15) is lea ing Macdonald College, where he has be attached to the Animal Husbandry Depa ment, to accept a position as Bacon Spe ialist in the Dominion Live Stock Branc He comes to Ottawa on December 10th

EDITORIAL

GRADUATE SCHOLARSHIPS IN AGRICULTURE

In the September, 1922, issue of *Scientific Agriculture*, reference was made to the increasing demand for men with specialist training in agriculture and the importance of encouraging such training in every possible way. It was suggested that the giving of scholarships to qualified and deserving applicants would be an excellent way of meeting a serious situation. There are many agricutural problems of tremendous national importance, the solution of which would mean millions of dollars to this country—problems in animal pathology, in the breeding of hardier and more resistant varieties of fruit trees and field crops, in the control of insect pests and fungous and bacterial diseases, in increasing soil fertility and in scores of other directions that could be named. There are many men in Canada working on these problems today who are willing and anxious to equip themselves better, through specialist training, so that they may be of greater service to Canada and to their profession. Unfortunately these men, in practically all cases, are working for small salaries and are unable to afford the cost of the graduate studies that are so essential to them.

Surely there is a solution to a situation so serious. The establishment of scholarships, each of at least $500.00, to be given annually to five or ten men, in order that they may obtain from one to three years of additional specialist training, is a tangible beginning, and it is gratifying to know that the Canadian Society of Technical Agriculturists intends to establish such scholarships in 1923. No enterprise is more deserving of public support and there is no organization in Canada through which graduate scholarships can be given with more satisfaction to the contributors than the C.S.T.A. The objective of five scholarships in 1923 is one that should be reached quite easily.

Announcement has been made, in the daily press, that the Society is now appointing a Board of Trustees for the administration of a Graduate Scholarship Fund. This Board will, in co-operation with the Dominion Executive of the Society, undertake to obtain contributions from private individuals, as well as from firms and corporations. There will be also appointed a Credentials Committee which will be responsible for selecting the successful applicants. The selection of five applicants will be a difficult task but the chief factors taken into consideration will probably be, (1) the economic value of the problem to be investigated, (2) the personal financial circumstances of the applicant and (3) previous training and general qualifications.

Many other details will have to be worked out. For instance, it should be provided that, after receiving his training, the applicant must either remain in Canada for a stated period of years or refund the amount of the scholarship. It would perhaps be advisable to encourage applicants to go to Canadian institutions for their training, if such institutions could provide the necessary courses. At present there are comparatively few subjects in which one can obtain advanced training in Canada. Our Canadian institutions, however, are doing more and more each year in the direction of advanced degree courses, and such courses are now being given at Macdonald College and at the Universities of Alberta, Saskatchewan and British Columbia.

Once the personnel of the Board of Trustees and of the Credentials Committee has been chosen by the Society, rapid results are

to be expected. The situation as it exists today demands consideration and calls for action. The technical agriculturist, the man engaged in investigational work, has never received the recognition or the encouragement that he deserves. Why not? Because the public is not kept in sufficiently close touch with his accomplishments, nor with the tremendous economic value of his researches. Canada must, in her own interests, give these workers—when they earn it—proper appreciation and adequate reward. The establishment of scholarships is a beginning and it will be interesting to know just what success the Society will have in this new effort.

SCHOLARSHIPS ENDOWED BY ADVERTISERS

The Canadian Society of Technical Agriculturists has attempted to develop, during the past eighteen months, a closer bond between the professional worker in Canadian agriculture and the reliable manufacturer. With that object in view it has always restricted the advertising pages of its official organ to such firms and products as were endorsed by qualified members of the Society and could be recommended by its members, throughout the Dominion, in their contact with students and farmers. In other words it attempted to acknowledge the financial assistance received from the advertiser, by giving in return a professional service or influence. In this way a closer connection, a deeper interest, has been created between the members of the Society and the firms who are financing the publication of *Scientific Agriculture*. That is a splendid spirit to foster and the effect of such a policy has been apparent in many ways.

A magazine such as *Scientific Agriculture* is not published for profit. Membership fees finance the Society, and advertising revenue very largely finances its magazine. A surplus is not expected from either. The continued support which this magazine has received from manufacturers suggested the possibility of setting aside, during 1923, a certain percentage of advertising revenue for the encouragement of agricultural research. Out of this suggestion developed the idea of scholarships endowed by the advertisers in *Scientific Agriculture*. This idea will be carried out as far as possible during the coming year. In this way a new interest will be added to our advertising pages, which are already well known on account of a selective advertising policy, and the bond between the members of the Society and the advertisers, will be strengthened. That is worth while.

AGRICULTURAL ECONOMICS

During the past decade the adoption of business principles in the operation of Canadian farms has been developing to an encouraging extent. It has become more and more apparent that profits from farming do not depend altogether upon large acreages and improved methods of production. The business element is recognized as a vital factor and farming is essentially a business, subject to the same conditions as any other industry or profession. As a result of this growing appreciation, we find that more attention is being paid, by progressive farmers, to the economics of farming or, in other words, to the principles of farm management; more study in being given to market conditions, to the problems of distribution and selling, and to many other factors that enter into the application of economic principles to farm practice.

Our agricultural colleges have met this situation by providing, in their curricula, for courses in Rural Economics and Farm Management, so that the youth from Canadian farms, who are able to attend these Institutions, may acquire a knowledge that was not available to agricultural students until quite recently. The courses being given today will, it is hoped, become more thorough and efficient as time goes on.

The number of farmers, and farmers' sons, who are able to benefit from this training in the *business* of farming, is very small. It is therefore gratifying to know that an institution such as the Shaw Correspondence School of Toronto, is recognizing the need, and is providing a course of one hundred lectures, by mail, in Rural Economics. The course is prepared by experts and covers every phase of the subject. It should be of as much value to a good many agricultural graduates as to the class for whom it is specially planned—the modern Canadian farmer.

The Mechanism of Heredity.

BY MORLEY A. JULL,

Macdonald College, Que.

The inheritance of characters in the breeding of animals involves a specific mechanism and a knowledge of that mechanism must precede the more fundamental lines of achievement. The greatest progress toward an understanding of the mechanism of heredity has been made in the fields of genetics and cytology. Great as that progress has been in recent years, however, the facts established will probably prove to be merely superstructures and it is highly conceivable that the more fundamental facts of the mechanism of heredity will be developed in the field of bio-chemistry. The problem of the mechanism of heredity, as developed up to the present time, is confined to the germ cells which contain the physical basis of heredity. The problem centres in the structures and functions of the germ-cells, which form the only bond between generations and between species. Moreover, evidence is rapidly accumulating which supports the hypothesis of the individuality of the chromosomes, as constituent parts of the nuclei of germ cells.

The most convincing evidence regarding the individuality of the chromosomes is apparently the case of Ascairs, where there are two varieties, one with two chromosomes and the other with one chromosome, in the haploid condition. Quoting from Morgan: "A few females have been found in which the unfertilized eggs contain one of these numbers, and all of the spermatozoa that have been received from another individual the other number. In such cases the fertilized eggs, and all embryonic cells, have three chromosomes each; this number is retained through all subsequent divisions, despite the fact that after each division a resting stage intervenes." Other evidence along the same line has been furnished by Boveri, also in the case of Ascaris, where daughter halves of the same chromosomes show the same identical irregularity. Bridges has shown that in *Drosphila melanogaster* a female sometimes appears through nondisjunction with two X's and a Y-chromosome and that when an XXY egg is fertilized by a Y sperm an XXY embryo results which contains its two X's and its Y throughout all cell-divisions. Federley, Harrison, and Doncaster, in certain crosses between moths with different numbers and sizes of chromosomes, have shown that the cell of the hybrid contains half the number of each species. Moenkhaus, Morris and Pinney, in crosses between different species of fish, with distinct size differences in chromosomes, have shown that the embryonic cells may continue through their divisions to retain the characteristic chromosomes of both species. Chromosomes themselves are composed of chromomeres and Wenrich has shown that in certain chromosomes of a grasshopper there are specific chromomeres occupying particular positions and that some of these chromomeres preserve their identity throughout the resting stages and are therefore persistent structures. Alhough the number of chromosomes in a given species is usually constant, McClung has shown that the number may not always be constant, owing to fragmentation or duplication. But there is apparently a constant number of chromomeres in every species.

CHROMOSOMES AND HEREDITY

Genetic and cytological evidence has fairly definitely established the fact that the chromosomes are the bearers of heredity. Since the evidence from genetics far outweighs the evidence from cytology most of the subsequent discussion, regarding the behavior and assumed structure of the chromosomes, is related to the results of genetic research. The several lines of evidence that hereditary factors are located in the chromosoms include:

1. The general equivalence of germplasm and of chromosomes in egg and sperm,
2. The equal distribution of chromosomes to all cells,

3. The conjugation and reduction of maternal and paternal chromosomes.

4. The doubling of chromosomes and of factors in fertilization.

5. Sex determination and sex chromosomes,

6. Abnormal distribution of chromosomes and factors,

7. Linkage and interference of factors and the linear order of factors.

8. Limitation of linkage groups.

1. In general, offspring inherit as much from one parent as another so that the egg and the spermatozoon are considered as equivalent as regards the transmission of most characters. The egg at the time of fertilization contains a relatively large amount of cytoplasm, yolk and other substances in the cell-body while the spermatozoon contains very little of these substances and usually its head only enters the egg, leaving the tail and most of the cytoplasm outside. The egg nucleus contains a characteristic number of chromosomes and the head of the spermatozoon consists almost entirely of a condensed nucleus in which is also the same characteristic number of chromosomes. The egg and sperm nuclei come together within the egg and their chromosomes mingle but do not fuse together nor lose their identity. The chromosomes from each nucleus are not only equal in number and size but are also alike in shape, excepting sometimes the sex chromosomes, so that in every fertilized egg there are two sets of homologous chromosomes, one set from the female and the other from the male. Since the chromosomes are the only portions of the male and female germ cells that are approximately equal in volume it is therefore highly probable that they are the bearers of hereditary factors. If the cytoplasm took any preponderant share it is hardly possible to believe that the maternal characters would not be more strongly developed in the offspring than the paternal. It is true, of course, that through chemical interactions between cytoplasm and nucleus the cytoplasm may play a more significant rôle than is now known but this point cannot be discussed in detail, and, moreover, it does not invalidate the above assumption respecting the significance of the chromosomes as bearers of hereditary factors.

2. The chromosomes are the only portions of the egg and sperm which are distributed equally to every cell. At the first division of the fertilized egg and at every subsequent division each chromosome divides equally and its halves go into the two daughter cells. Every cell of the adult organism contains one full set of chromosomes from the egg and another from the sperm. This is further evidence that the chromosomes are the bearers of hereditary factors.

3. In the process of syndesis, or conjugation of the chromosomes, it has been shown that homologous chromosomes always pair. The pairs are called bivalent chromosomes and in some cases it has been demonstrated that one member of each pair comes from the female and the other from the male.

In all ordinary divisions, (equational), every chromosome splits in two and the halves go into the daughter cells, but in one or other of the last two divisions, (reduction)' leading to the formation of the germ cells, the pairs separate, whole chromosomes going into the daughter cells. The chromosome number is then reduced, from the diploid to the haploid condition.

Since one chromosome of each pair is from the female and one from the male and since these chromosomes separate freely in the reduction division, it follows that each gamete contains one full set of chromosomes, some of which are from the female and others from the male, but only one chromosome of each pair is found in any gamete. The phenomenon of segregation was one of the two fundamental principles of heredity discovered by Mendel, and to-date hundreds of cases might be cited as proof. Morgan points out that "a crucial test of the correctness of the assumption that segregation of the members of a pair of elements takes place in the germ-cells of the hybrid, consists in back-crossing the hybrid" to the recessive of the parent stock. "Such a cross should show whether the germ-cells of the hybrid are, as postulated, of two sorts, and whether equal numbers of each sort are produced. Mendel made such tests, and obtained equal numbers of two kinds of offspring."

All hybrids carry two sets of factors, derived from the female and male parents, but in the formation of the gametes these factors separate so that every germ-cell is pure with respect to any character. In this respect the invisible factors behave exactly as do the visible chromosomes. It would be difficult to invent a more perfect mechanism for the segregation of factors than is found in the union of maternal and paternal chromosomes into pairs and their subsequent separation in the reduction division.

4. The union of female and male gametes, each having the reduced or haploid number of chromosomes, restores the somatic or diploid number of the species. The chance combination of chromosomes in fertilization gives the same mendelian ratios as the chance combination of inheritance factors. Hundreds of results from breeding tests might be cited to illustrate the independent assortment of factors. One case will suffice. A cross between a *Drosophila* male with recessive vestigial-wing and dominant gray body-color factors and a female with dominant long-wing and recessive ebony body-color factors produces hybrid flies having long wings and gray body-color. The hybrid flies when inbred give the proportion of nine long-wing, gray body-color flies to three long-wing, ebony body-color to three vestigial-wing, gray body-color to one vestigial-wing, ebony body-color fly. Using symbols in terms of recessiveness the above results are interpreted thus:

vvEE x VVee = VvEe (F1)
VvEe x VvEe = 9VE : 3Ve : 3vE : 1ve (F2)

Independent assortment of the two pairs of factors Vv and Ee gives four kinds of germ cells both in males and females, thus:

Male	Female	Genotypes	Phenotypes
VE	VE =	1VVEE+2VVEe+2VvEE +4VvEe=	9VE
Ve	Ve =	1VVee+2Vvee	—3 Ve
vE	vE =	1vvEE+2vvEe	—3 vE
ve	ve =	1vvee	—1

Any of the four kinds of sperm may fertilizer any one of the same four kinds of egg, giving the above results in genotypes and phenotypes. In this case two pairs of factors are involved, but the same principle of random assortment holds goods for any number of factors. Jennings has expressed this principle in simple language: "The number of diverse combinations possible in the half nuclei formed from nuclei all of the same kind is 2^n, if n is the number of diverse pairs of chromosomes present in the original nuclei. If there were n pairs of chromosomes present in the original nuclei, then by the formation and mating of germ cells in the way described, the number of different combinations producible is 3^n."

The phenomenon of chance combination of gametes is stressed because without random assortment there could be but two kinds of gametes produced by the hybrid, yielding the possibility of but three types in the second hybrid generation, the two grandparental types and the hybrid type. Since the assortment of chromosomes is a random one, however, the reduction division furnishes the mechanism necessary for a logical interpretation of Mendelian inheritance.

It has been pointed out that genetic results demonstrate the random assortment of the factors. Now cytological evidence is available to show the same thing. In studying the behavior of an unequal pair of chromosomes in relation to the sex-chromosome in *Trimeropteris,* Carothers observed random assortment to take place. She also observed purely random assortment in the case of several chromosomes that show terminal or subterminal attachment of fibres. Robertson, Voinov and Wenrich have reported similar results.

5. In many plants and animals sex is inherited as a Mendelian character, one sex being homozygous and the other heterozygous for this character. There are more than one hundred species of plants and animals in which the female is homozygous while the male is heterozygous. Eggs fertilized by one type of sperm produce males and by the other type females, as illustrated in the following reciprocal crosses, the symbols being used in terms of recessiveness. If a male *Drosophila* with white eyes is mated to a female with red eyes the first hybrid generation sons and daughters all have red eyes. When these are inbred, all the second generation daughters have red eyes, half of the sons have red eyes and half of the sons have white eyes.

(1) w— x WW = 1Ww : 1W—
W— x Ww = 1WW : 1Ww : 1W— : 1w—

In the reciprocal cross where a male with red eyes is mated to a female with white eyes the first hybrid generation daughters have red eyes and the sons have white eyes. When these are inbred half of the second generation daughters have red eyes, half have white eyes, half of the sons have red eyes and half have white eyes:

(2) W— x ww = 1Ww : 1w—
w— x Ww = 1Ww : 1ww : 1W— : 1w—

The above crosses show that an egg fertilized by one kind of sperm produces males—(e.g. in the second cross a "w" egg fertilized by a "-" sperm produces "w-" males)—and an egg fertilized by the other kind of sperm produces females— (e.g. a "w" egg fertilized by a "W" sperm produces "Ww" females). The crosses also illustrate the phenomena of sex-linked inheritance, of which are fifty cases in *Drosophila.*

In a few cases in Lepidoptera and in birds there is evidence that the female is heterozygous for sex and the male homozygous. In regard to birds, however, Guyer has observed that in spermatogensis two kinds of spermatozoa are produced but that one kind does not function.

In both types of sex-inheritance chance combination of the germ cells produces equal numbers of homozygotes and heterozygotes, which fact explains the numerical equality of the sexes. Whether sex is determined by the sex-chromosomes is a debatable question which cannot be discussed here, since the only point to be made is that the absence of a whole chromosome, as has been observed in the case of many males, gives ocular proof of the chromosomal theory of heredity.

6. The first cases of abnormal distribution of chromosomes and factors were used as proof against the theory of the chromosomes as bearers of hereditary factors but it has turned out later that these very cases are, in general, additional proof of the chromosomal theory. But few cases need be given to illustrate the point at issue.

In Boveri's classical example of dispermic sea-urchin eggs it was observed that different cleavage cells receive a different number of chromosomes and in general those cells which receive the largest number develop most typically, while those which receive a small number develop atypically. It was subsequently found that normal development depends not so much upon the absolute number of chromosomes in a given cell as upon a complete set of all the different kinds of chromosomes. Thus Boveri proved that different chromosomes of a set differ in hereditary value.

Bridge's case of non-disjunction in *Drosophila,* referred to previously, illustrates very clearly the correlation between the presence or absence of a particular chromsome and the presence or absence of particular characters in the developed organism. The occasional appearance of a matroclinous daughter or a patroclinous son was observed to be due to the fact that the XX pair of chromosomes failed to separate in the reduction division of the egg, or both were extruded in the polar body, or the XY pair failed to separate in the reduction division of the sperm so that one sperm had both and another lacked both of these chromosomes. A patroclinous son is the result of the fertilization of an O egg by an X sperm. Such an XO male is sterile while the normal XY son is fertile, showing that the chromosome Y has some function though apparently it does not contain any of the factors.

7. The free assortment of the factors has been mentioned as the second fundamental law established by Mendel but as the geneticists' knowledge of the mode of inheritance extends, the number of cases increases in which free assortment does not occur. Many characters have been observed which keep together in successive generations and this phenomenon is called linkage, of which there are varying degrees, ranging from those characters which tend to stay together completely to those which show only a slightly greater probability of staying together than of assorting freely. Illustrations of sex-linkage have already been given but the following crosses illustrate the phenomenon of complete linkage of factors located in an autosome, the second chromosome, of *Drosophila.* The symbol "b" represents black body-color and "B" its moral allelomorph gray body-color, while "v" represents vestigial wings and "V" its normal allelormorph long wings.

(1) — Black vestigial × gray long = gray long
bv bv × BV BV = BV-bv

gray long × black vestigial = gray long : black vestigial
BV-bv × bbvv = 1BV-bv : 1bbvv

(2) — gray vestigial × black long = gray long
Bv Bv × bV bV = Bv-bV

gray long × black vestigial = gray vestigial : black long
Bv-bV × bv bv = 1Bv bv : 1bVbv

The above crosses show that the combinations that went in together come out together, regardless of how the original crosses are made. The genetic results follow the chromosome behavior, providing there has been no interchange of factors in the male. This last fact is established, as may be observed when the F_1 male in each cross was mated to a double recessive female. It may be said, then, that the male *Drosophila* exhibits complete linkage, and this has also been proven for the female of the silk-worm moth.

"On the other hand, there is an interchange of blocks of factors between homologous pairs of chromosomes in other cases, as in the female *Drosophila,* in the males of moths and fowls, and in both egg-cells and sperm-cells of the plant Primula. This interchange is called crossing-over, and the evidence shows that it is not haphazard, but gives numerical results of extraordinary constancy" (Morgan). The percentage of crossing-over is definite for a given stock of a given age under given environmental conditions.

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(1) — black vestigial × gray long = gray long
bbvv × BBVV = BbVv

gray long × black vestigial = 41.5% BV: 8.5% Bv: 8.5% bV: 41.5%bv.
BbVv × bbvv =

The interchange is independent of the way in which the factors enter the cross.

(2) — black long × gray vestigial = gray long
bbVV × BBvv = BbVv

gray long × black vestigial = 8.5% BV: 41.5% Bv: 41.5%bV: 8.5% bv.
BbVv × bbvv =

Crossing-over can only be recorded when two or more pairs of factors are involved and for each two pairs there is a definite numerical ratio. When more than two pairs of factors are involved double crossing-over may occur. From a vast amount of work on crossing-over in *Drosophila,* Morgan and his pupils have demonstrated the linear order of the factors in the chromosomes. Bridges has shown that the farther apart in a chromosome any two factors are the greater is the amount of crossing-over between them. Where the factors are very close together the phenomenon of interference occurs and there is less single and double crossing-over than would otherwise be expected. The segment of the chromosome between breaks tends to be of a particular modal length. The first chromosome of *Drosophila* is 65 units long and Weinstein has determined that the modal length is 46 units. The second chromosome is 107 units long and Robertson has determined a modal length of 15 units in the centre and a modal length of 30 units on either side of the middle point. Plough has determined that crossing-over does not take place earlier than the conjugation of the chromosomes. In experiments planned to detect the relation between temperature effects and crossing-over Plough found that in a just-hatched virgin female 125-175 eggs are laid before the

effects of heat are shown. Since in a just-hatched female about 150 eggs are present that have passed beyond the conjugation period, it is evident that crossing-over cannot be affected earlier than conjugation. Regarding the results of the Morgan school, Conklin says: "This work of Morgan and his associates on the localization of genes (factors) is in all respects the most remarkable work which has ever been done in this field; for the first time it gives us a detailed picture of what Weismann called the 'architecture of the germplasm'—for the first time it assigns to different genes 'a local habitation and a name.' "

8. The phenomena of the limitation of linkage groups, established in the case of *Drosophila,* is another line of evidence concerning the chromosome theory of heredity. It has been shown in *Drosophila,* with over 200 characters involved, that the linkage groups correspond in number to the chromosome pairs. The same situation is gradually being shown to exist for other animals.

CYTOPLASM AND HEREDITY

Although all the evidence given previously demonstrates that the chromosomes are the bearers of hereditary factors, it does not follow that the cytoplasm exerts no influence on the hereditary mechanism. It may be that the cytoplasm does not exert a preponderating influence, but more information is gradually being gained regarding chemical interactions between nucleus and cytoplasm.

In the case of both female and male sex cells the cytoplasm is differentiated and many differentiations of the cytoplasm of the egg persist and play an important part in embryonic differentiation. The polarity of the egg appears to determine the polarity of the embryo and adult. In many cases the eggs are bilaterally symmetrical and in the egg of the frog it was thought that the path of the spermatozoon within the egg determined exclusively the plane of bilateral symmetry but Brachet has shown that primary bilateral symmetry is present before fertilization. Conklin says that "It is probable that all bilateral animals come from eggs which show a similar primary bilaterality and that this differentiation precedes fertilization." It has been well established by Crampton, Kofoid and Conklin, that certain cleavages in the eggs of gasteropods correspond to the reversal of symmetry in the larva. The inverse symmetry may be traced back through the later and earlier cleavage stages to the unsegmented egg itself which is inversely symmetrical in dextral as compared with sinistral forms.

The relative importance of cytoplasm is further evidenced by the fact that the type of egg organization foreshadows the type of adult. That the spermatozoon does not affect the pattern of egg organization is shown by the fact that in many cases it exists before fertilization takes place. Then again, in heterogenous fertilization the foreign sperm does not change the pattern of the egg. Thirdly, the existence of the pattern in the absence of fertilization is demonstrated by natural and artificial parthenogenesis.

Most of the cytoplasmic differentiations of the egg and sperm arise during the genesis of those cells, and the egg differentiations persist in the new individual while those of the sperm do not. In each generation, therefore, the egg contributes more than the sperm. There is cytoplasmic inheritance through the female only, but some of these cytoplasmic characters may be of biparental origin.

Finally, it may be said that germ cells are as specific as developed organisms. Different germ cells from the same individual frequently differ in hereditary constitution and different chromosomes of the same cell differ in hereditary value. The correlated hereditary resemblances and differences in adult organisms and in the germ cells from which they come are accounted for by the fact of the specificity of gametes and zygotes which function in the mechanism of heredity.

ERRATUM.

In the last issue of *Scientific Agriculture,* the footnotes for Table I of the article on "Oat Production in Saskatchewan" were omitted. This table was printed on page 127, and the footnotes are as follows:

(1) Dropped from standard variety tests.
(2) First year in standard variety tests.
(3) Returned to standard variety tests.

Origin of False Wild Oats.

A Review

BY L. H. NEWMAN,

Secretary, Canadian Seed Growers' Association, Ottawa.

The appearance in ordinary cultivated varieties of oats (*Avena sativa*) of what are known in Canada as "False Wild Oats" has been a matter of common observation in this and other countries for many years. These forms do not appear in great numbers but may be found occasionally both in white and black grained sorts. They resemble the common wild oat *Avena fatua* quite closely in all essential particulars, having the sucker mouth, the hairy callus and the long, twisted and bent awn peculiar to the latter species. On the other hand, the form and colour of kernel as well as the type of plant of the "False Wild Oats" does not correspond with that of the true wild species but is the exact counterpart of the variety in which it is found.

The origin of these forms has long been a matter of speculation and investigation. Some authorities, notably Tschermak, Zade and Surface have expressed the opinion that they may be the result of natural crossing between the wild and cultivated forms. This indeed seems at first sight to be the most logical explanation and is the one most commonly held and feared by seed growers. Other authorities claim that they are not the result of crossing but arise as a result of some independent change within the oat plant itself. In 1912, an interesting bulletin entitled "Wild Oats and False Wild Oats, Their Nature and Distinctive Characters" (Bulletin No. S. 7) was published by the Dominion Seed Branch, Ottawa. The author, Mr. Norman Criddle, describes in this bulletin the results of some seven years' investigations conducted on his own farm at Treesbank, Manitoba. While he believed that these forms may possibly arise as a result of a cross between the wild and cultivated species, yet in view of certain facts he is inclined to doubt that they are produced in this way. On the other hand, he does not hesitate to conclude that "False Wild Oats" should not be classed as a noxious impurity when found in cultivated sorts as they do not multiply as do the true wild species but seem to be held in check by nature.

In the book "Plant Breeding in Scandinavia"—(Newman) * which appeared in 1912, there is given a summarized opinion concerning the origin of these aberrant types as held by the experts, notably Dr. Nilsson-Ehle, engaged in plant breeding work at the famous plant breeding institution at Svalöf, Sweden. As a result of extensive investigations covering several years of very careful work the opinion was expressed that "False Wild Oats" have their origin chiefly as a result of certain spontaneous changes or mutations which may take place in any of our cultivated varieties. The mutation in question is considered as a negative or retrogressive sort representing a change from the dominant to the recessive character of a given Mendelian pair.

Since the above date this question has been investigated further, a report of which by Dr. Å. Åckerman, Dr. Nilsson-Ehle's successor, has been published recently. ** This report indicates that these later investigations only serve to strengthen the opinions expressed ten years ago.

In the United States the origin of these aberrant forms has been investigated at considerable length. In the "Journal of Heredity" for January 1922, there appears an excellent article by R. J. Garber of the Agricultural Experiment Station, Morgantown, West Virginia, reporting an investigation seeking to expain their appearance.

As Hjalmar Nilsson of Sweden first observed, "False Wild Oats" do not show their complete development necessarily when first observed. In other words there are Heter-

*Published by the Can. Seed Growers' Ass'n, 114 Vittoria St., Ottawa. See page 71.

** See "Undersökningar rörande flyghavrelika mutationer i vanlig odlad havre" Å. Åkerman, Sid 265-7 Utsädesförenings Tidskrift, Häfte 6, 1921.

ozygous F.W.O. and there are Homozygous F.W.O. thus suggesting segregation following a cross. This fact has made it difficult for many to interpret their origin as being due to anything other than natural crossing. It has been found, however, that mutations may act much as do crossings and produce progeny which are both homozygous and heterozygous in character. * *

In 1920 Garber found both of the above forms in a pure line of the Victory variety. These were quite easily distinguished from each other as well as from the parent variety in respect to development of awn, articulation of the seeds and pubescence around the articulation. The "False Wild" forms in both cases, however, bore kernels practically identical with those of Victory. In 1921 seed from individual plants from each of the above three categories was planted separately and in all cases produced seed which corresponded in form and colour with the Victory. The Homozygous forms also bred true in other respects as did the Victory while the Heterozygous forms segregated into sativa-like forms as well as Heterozygous and Homozygous False Wild forms.

In 1915, the same author observed False Wild forms of both kinds growing in the Garton 784 variety which is characterized by having black kernels and a side panicle. Here the Heterozygous form as well as the Homozygous had black kernels and a side panicle corresponding closely in these respects with Garton 784. The last two forms bred true but the Heterozygous segregated. The ratio obtained in the segregation of the two varieties Victory and Garton 784 considered together was approximately 1: 2; 1: the ordinary monohybrid segregation.

Only two plants of False Wild oats were found by Garber in another variety called Aurora, which variety is characterized by having short plump yellow kernels. These two forms bred true and produced kernels practically identical in colour and shape with those of Aurora.

In connection with this investigation a number of interesting crosses also were made between the true wild oats and Victory and between the former and Garton 748. Crosses were also made between *Avena fatua* and *Avena orientalis*, also between tory (white) and Garton 784 (black). discussing the results of these crosses author states: "From the facts brought above and from an examination of the figu it is obvious that the segregation obser in the F_2 generation of *fatua-Victory* cro and *fatua-Garton* 748 crosses is very dif ent from that in the progeny of heterozyg false wild oats. In the latter there is parently but a single factor difference volved whereas in the *fatua* crosses there undoubtedly several factor differences inv ed." He draws attention further to the sig ficant fact that whereas in crosses betw such sorts as Victory (white) and Gar 784 (black) there is a definite segregat as regards colour yet in none of the ca investigated has he found the Heterozyg False Wild forms to segregate as regards t character. After a minute examination i all the facts connected with the case the au or finally concludes that "it is more p bable that Nilsson-Ehle's hypothesis is c rect, namely that the False Wild oats is t result of mutation."

Observations made in Canada by the Can dian Seed Growers' Association covering a p iod of almost 20 years would seem to supp the above conclusion. We recall amo many other instances, the frequent appea ance of these forms in a strain of oats whi has been grown continuously by a Prin Edward Island grower for over twenty yea to the practical exclusion of all other sor In the district in question, true wild oats a unknown in so far as the writer has be able to ascertain, yet these wild oat-li forms occasionally appear in the fields this grower. Analyses of the samples tak annually from the crop in question furth more, do not indicate that the percentage these forms has increased during all the years. As a matter of fact, they are fou only occasionally and are ignored in far as being of any economic importance concerned. From a practical standpoint is of interest to have such convincing e dence as is now available to show that th long suspected forms do not seem in a way connected with true wild oats and c not be considered as a dangerous weed any sense.

** For a technical explanation of what is supposed to take place in connection with the production of these forms see "Plant Breeding in Scandinavia" page 71.

Canadian Agricultural Products in British Markets.

A Timely Statement by

DR. J. H. GRISDALE,

*Deputy Minister of Agriculture for Canada.**

As most of the readers of *Scientific Agriculture* know, I have recently returned from Great Britain where I went in an advisory capacity to Honourable W. S. Fielding, Minister of Finance, and Honourable E. Lapointe, Minister of Marine, who were delegated as representatives from the Dominion Government, to conduct negotiations with the Imperial Government looking to the preparation of an agreed bill to submit to the Imperial Government for lifting the long time embargo that now prevents us shipping live cattle to Great Britain, save for immediate slaughter. †

This embargo has been in effect for thirty years or thereabouts, and its lifting has been bitterly opposed by many of the cattle breeders in the Old Land. It is only fair to say, however, that it has been, and still is, just as strongly contended by many farmers and certain cattle breeders, that the embargo should be lifted. I am of the opinion that once the embargo is lifted, very considerable business will develop in this line.

The demand for stores is keen in Great Britain, and the number of stores actually being fed at present falls very considerably short of what could be, and would be fed if available. The opening of the British market to Canadian stores will therefore be welcomed by many British farmers anxious to feed, but prevented at present by lack of cattle.

The demand, it must be remembered, however, will be for our well bred, good type stores. Inferior or commonplace cattle will get a cool reception, and will very certainly prove a losing proposition to both producer and shipper, as the chances are that they would sell for very little more than the freight and other expenses. Unfortunately, there are too many of this inferior type of cattle in Canada today, and it is essential that every farmer interested in the breeding of cattle for this trade, or for beef production in Canada alone even, should see to it that one half his herd at least, that is the bull, is right, before starting operations this winter or next spring.

While it will take a few years to get rid of the too great proportion of inferior cattle, many of them now being put on the market as stockers, there is, of course, a very considerable percentage of good stuff in the country, and this is the stuff that should go forward to meet this store trade once it is opened up, since it is exceedingly important, and even imperative, that only the very best type of animal should go to this new market if we are to hope to build up a trade and maintain the demand that will make the business profitable to all concerned.

Once the Imperial Parliament has passed legislation along the lines announced by the Minister of Agriculture some few weeks ago for lifting the embargo, the only obstacle remaining will be the high freight rates which now maintain on the railways in this country, on ocean vessels and on the railways in Great Britain as well. Canada is making an effort to gradually lower these transportation costs on her railways; freight rates are coming down to some small extent in January next in Great Britain, leaving the ocean

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* Although much of the information given in this statement has already appeared in the daily press and the agricultural press, it is published here in complete form so that it may be a permanent reference for technical and professional workers in Canadian agriculture.—EDITOR.

† Since this article was prepared for publication, the British Government passed, on December 12th, the legislation to which frequent reference is made by Dr. Grisdale. EDITOR.

transportation charges the only part of the cost that does not at present show a tendency to decrease. There is no doubt, however, that once a good trade offers, more ships will go into the business, and so compel lower charges through competition which does not seem to exist at present. It is possible, even, that the Canadian Government Merchant Marine might take a hand in this business, and so help put it on a good sound footing.

Some adverse comment has been noted in connection with the three-day quarantine required in this country previous to embarkation on board ship, but there is absolutely no ground for any anxiety as to the effect of this quarantine on the cost of shipments, since where cattle are shipped direct from, say, Edmonton, Calgary, or even Winnipeg, the quarantine period will be much more than taken up in transit, and even in the case of cattle from Toronto, the day usually required for getting them together, loading, and so on, the day or so in transit and the day in the Port of Montreal, make up the necessary three days, and the probabilities are that the quarantine period will not have delayed shipment one hour, nor added one cent to the total expense of getting the cattle across to Great Britain.

The inspection on this side will, of course, for some time at least, be done by this Department free of cost. The inspection in Great Britain will, however, have to be paid for by the shipper, but as the fee is to be only six pence per head, or eleven cents at the present rate of exchange, surely no objection can be raised.

It should be noted too that the regulations under which fat cattle are at present admitted for slaughter at certain ports are not to be modified in any way, the only conditions to observe in this connection being that, where fat cattle are shipped as fat cattle, that is, have not complied with the inspection and three-day quarantine under observation regulations discussed above, then no stores or stockers shall go on the same ship with such fat cattle. There will be no objection, however, to fat or half fat cattle going forward as stores, that is, complying with the quarantine and inspection requirements for stores, and then, on arrival at British port, going direct to the slaugh house in case they land at Liverpool Glasgow, if there should be a good mar for fat cattle at the time.

In the case of females, there was at fi apparent a very strong objection by the B tish delegates to their being considered coming under the category of store catt and it was strongly contended that th should submit to a thirty-day quarantii and the tuberculin test before being admitt into the country, but, inasmuch as it w quite apparent to Mr. Duncan Marshall ar myself, the advisory part of the Canadia delegation, that there was likely to be very strong demand for grade females, pa ticularly for milk production, the Canadia representatives were most urgent in the demand for better terms in connection wit admission of stock of this kind. Finally was stated that the very most the Imperia Government could concede was that Cana dian breeding stock should be admitted, pro vided they had passed the tuberculin tes within thirty days of embarkation, and tha they should be subject to the same condi tions of inspection as the stockers and spayed heifers, but that the three-day quar antine should not apply, although, of course that would really make no difference.

The admission of breeding stock is, however, subject to control by order, hence might be stopped at the will of any Govern ment, or blocked by an adverse vote in the House. This feature was, of course, not very acceptable to the Canadian delegation but it was maintained by the Imperial representatives at the conference that it was the best that could be done just at present.

The announcement of this agreement, as it was approved for sending to the British press, made it clear that such regulations as would permit of the admission of breeding stock into Great Britain, would be laid on the table of the two Houses of Parliament, as soon as the enabling legislation was passed, thus indicating clearly that it is the intention of the present Government to implement, by the necessary order, the legislation agreed upon, as soon as such legislation has been passed.

There was evident, on the part of both the Imperial representatives, and the offi-

cials taking part in the conference, the very greatest desire to meet the wishes of the Canadian representatives, and a very strong feeling of amicable co-operation between the Imperial and the Canadian representatives was apparent throughout the whole proceedings. I cannot speak too strongly of the evident sincere desire on the part of the Imperial delegates and officials to meet the recommendations of the Canadians, or modify their own proposed conditions in such a way as to comply as far as possible with the changes suggested by the Canadian delegation.

I spent nearly six weeks in Great Britain, most of it in London or the near neighborhood thereof, attending the conferences in connection with the 'lifting of the embargo question,' but as may be imagined, I had a good deal of time between meetings which I attempted to spend profitably by looking into our agricultural trade in order to ascertain the actual conditions maintaining on the beef, bacon, butter, cheese and egg markets, the general character of the produce shipped to these markets from Canada and the esteem in which our produce is held by the handler and the consumer.

It is just a little unpleasant to have to say that according to statements made to me by some of the more important commission men and others interested in such produce as we ship to Great Britain, and to judge by the reputation enjoyed by our produce some few years ago as compared with similar produce shipped by our competitors in Denmark, Holland, New Zealand, Australia, South Africa and Argentina we, in Canada, have not been making quite as much progress in the improvement of the appearance and quality of our exports as have some of the above mentioned competing countries, since, in many cases, produce from these countries looks better and sells better than similar produce from Canada today. It became quite evident to me as I pursued my enquiries and continued to compare Canadian products with similar products from one or another of these competing countries that in very many cases indeed were these competing countries sending goods superior in appearance, at least, to those coming from Canada. One most striking peculiarity in favour of many of the products from our competitors was the uniformity in appearance and quality as contrasted with the great lack of uniformity in appearance and quality in our Canadian products, this applying more particularly, of course, to bacon, cheese and butter.

In the case of bacon, in which too great a proportion of the sides in evidence were too short and just slightly too thick, as compared with the Danish which easily topped the import market and were usually selling for fifteen or sixteen shillings per cwt. (112 lbs.) that is, somewhere around three cents per pound, more than Canadian bacon wholesale, and to judge by what I could learn from the retail sellers, which was very little, the difference was possibly greater relatively in their case than in the case of the wholesalers.

Our butter, due to variation in quality, is at a great disadvantage as compared with butter from New Zealand and South Australia where the output of individual factories is very great, and where cattle are on grass the year round. The lack of trade names for Canadian butter is a further disadvantage to our products and a disadvantage that is hard to overcome. In addition, our packages do not seem to be as well made and are certainly not as attractive looking as those from our antipodean competitors, and the finish on the butter and the wrapping again show up to disadvantage.

Our cheese, while still enjoying an excellent reputation, can hardly be said to now hold the first place on the British market since, while it may sell for only a few cents less a cwt. or possibly the same price even, it is not commonly taken as first choice, the New Zealand article now enjoying that distinction. This is done, it was claimed by some of the commission men, to greater uniformity, to better packages and to a smoother texture, in a cheese slightly less acid coming from New Zealand.

In the case of eggs I am glad to say that due to the grading so rigidly enforced by this Department, our eggs enjoy a reputation second to none on the British market and show it by the price they command.

Our beef varies, of course, greatly from day to day. On one occasion when visiting the Smithfield market I saw frozen beef

from Argentina, chilled beef from Canada, fresh-killed Canadian beef from the lairages at Liverpool, fresh-killed Irish beef and Scotch prime beef all on display. The prices were illuminating. Canadian chilled shipped from Toronto was selling at 6d per pound; Canadian fresh-killed from Liverpool at 8d to 9d per pound; Irish fresh-killed at 8d to 9d; Argentina frozen 3½d to 4d per pound; Scotch prime about 14d per pound and the Argentina frozen selling at only 3½d per pound although considered somewhat better finished than the Canadian chilled beef; it was, however, rather rough which of course would account in some measure for the very low price.

The chilled beef, of which considerable quantities have been going forward from Canada for the last twelve or fifteen months, has, I have been credibly informed, not been making any money for the shippers and is, I understand, rather difficult to handle. It is possible that frozen beef, which can be handled much more easily, would prove more profitable than the chilled if it could be de-frosted in such a way as to prevent the leakage or loss of the juices which now always occurs when the meat is de-frosted in the usual short time on the Smithfield or other markets. It would be, in my opinion, highly advisable for us to carry on some experiments in this connection to see if it is not possible, by slow methods of de-frosting under more favourable conditions, to overcome this most injurious leakage effect.

Naturally while learning of the difficulties and setbacks above mentioned which are now doing not a little to injure our trade and our reputation as producers of first-class foodstuffs in the Old Land, I was looking around to learn, if I could, of ways and means of combating these difficulties and to get back for Canada, if at all possible, her previous rather easy domination of the British market, insofar as butter and cheese are concerned, and her better reputation in the bacon market. Since returning I have, therefore, made the following recommendations to the Minister of Agriculture who has agreed with me as to the importance of this country making every effort at least to maintain our present position and if at all possible better the same on the British market, a he has accordingly approved my recomme dations in this connection:

(1) That we appoint a first class bu ness man with a wide knowledge of agricu tural products to act as Canada's represe tative in Great Britain in connection wi our bacon, butter, beef, cheese and egg e ports; (a) to study conditions; (b) to mal recommendations to our Government and producers as to how improvements can brought about; (c) to help trade by jud cious propaganda in connection with ou products in the Old Land and (d) to be o use as a referee when necessary in trad disputes.

(2) That we, as a country, make mor effective displays at shows and exhibition of one kind and another, and participat more enthusiastically in such large exhibi tions as may be organized or engineere from time to time in the Old Land. W should, I believe, have good and attractive exhibits of Canadian products at the Royal Agricultural Show, and at the Highland Agricultural Show, the two greatest live stock shows in Great Britain, as well as at the London Dairy Show usually held in October, at the Fat Stock Show held in November or December and at the Fruit Shows held at various points from time to time. My reasons for this recommendation are that, at two shows which I visited, viz:— The London Dairy Show in October and the Fruit Show on the last days of October and first days of November, the advantages of a good display, as contrasted with a poor one, were very strongly indicated.

At the Dairy Show Canada was most remarkable for the very insignificant part she played and for the poor standing taken by her products in butter and cheese. The only booths representing Canada were from Ontario and Quebec, and even these, I am sorry to say, compared very unfavorably with the displays staged by some of the other colonies. South Africa, New Zealand and Australia were the topics of discussion on all hands. It really was anything but a pleasure for a Canadian to wander about that show and observe what was going on and listen to discussions among the commission men and citizens generally. There was absolutely no reason why Canada might not

have taken a high place in the competitions and have had displays quite worthy of her actual performance, and even of her possibilities as a country where the very best butter and cheese, bacon, eggs and beef are produced in large quantities and could be produced in much greater quantities if the Government, the interested agencies and the farmers will jointly and individually bestir themselves and take action in the right direction.

(3) I have to recommend that Canada take a most energetic and large part in the great Imperial Exhibition now being prepared for at Wembly Park, London. I took occasion to visit the grounds where this exhibition is to be held, and was greatly impressed by the preparations under way for this most tremendous Imperial Show to be held in 1924.

(4) I am strongly of the opinion that more thorough grading of our products must be brought into effect at once if we are to hold our own. The only product in which we do any grading worth mentioning at the present time is eggs, and when it comes to eggs Canada ranks highest, next to the home article or the Holland article, which, of course, comes over inside twenty-four hours. Thirty-dozen crates, Canada firsts, were quoted some shillings higher than American selected eggs, Americans being, of course, our greatest competitors.

I mentioned the difficulty the dairy produce from our small factories experiences in competing with the uniform article from large factories such as are found in New Zealand and Australia for both cheese and butter. This difficulty, in my opinion, can be overcome very largely if all our dairy products are closely graded into firsts and seconds with sub-grades in each, as, for instance, "Canada No. 1 colored"; "Canada No. 1 uncolored"; "Canada No. 1 grass"; "Canada No. 1 fodder" etc., which would give some basis for the commission men and the merchants to work on in the Old Land where now there is absolutely nothing, unless, possibly, the name of a commission man in Montreal or of some Co-operative Association, which, as everybody knows, means little insofar as uniformity of color or quality is concerned.

(5) We should, I believe, carry on propaganda in Canada along these lines, that is, with reference to the improvement of these products and the importance of insisting upon their being graded as they leave the country, and to impress upon the producer the importance of his doing his part to help.

(6) In connection with the beef business, the high freight rates maintaining are injuring both the chilled beef and the fat cattle export business. As already mentioned shipments of chilled beef have, it is claimed by the packers interested, proven unprofitable. It would seem to me highly advisable that an experiment be conducted to determine just where the difficulty lies, and I am recommending that a considerable number, say, a couple of hundred, fat steers be selected, one hundred to be killed and shipped as chilled beef and one hundred to go across alive, and the results observed on the Smithfield market. Such an experiment as this, together with some investigation into de-frosting methods, would, I believe, do much to clear up the fog of uncertainty which seems to hamper the development of the beef exporting industry of this country.

In conclusion I would say that while we seem to be struggling along under greater or lesser difficulties in the marketing of our products in the Old Land, there was evident, just the same on the part of the commission man or dealer, on the part of the prominent citizen and on the part of the consumer in all the cities and country districts I visited, from Southampton to Aberdeen and from Liverpool on the west to Kent in the south-east, a wonderfully warm feeling toward Canada and her people and her products which augurs exceedingly well, in my opinion, for the development of business and for the getting of immigrants of the right class into this country. My final word, therefore, to the producer and to the people of this country generally is—Canada wake up! Success and prosperity await our every effort, but mediocrity and failure follow in the wake of the course we now pursue, as there is nothing attained by our competitors as above referred to that we may not equal or surpass.

Injuries, Life History and Control of the Apple Sucker (*Psyllia mali Schmidberger*)

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Character of Injury.

Since the apple is the only host that suffers appreciable damage from this pest, this account is confined to a description of the results of its work upon that plant.

Our observations on the character of the injury induced by the apple sucker, agrees, in general, with that of earlier workers. The work of the nymphs affects both leaves and blossoms, but the latter injury is more conspicuous and more serious. There is a considerable difference in the general appearance of an infested tree bearing blossoms and a similar one of the same variety with no blossoms, the former showing much more injury. We have even noticed such a contrast on a tree with one limb bearing blossoms, while the rest of the tree was practically without blossoms. The greater injury noticeable on the blossom clusters is at least partly due to the fact that the proportional infestation is heavier than on leaf clusters. Though in exceptionally severe cases some of the blossom buds may be prevented from opening properly, the injury is usually not apparent until about the time the blossom petals fall, when the blossoms are seen to shrivel and become brown and dead. While the fruit on unaffected trees is developing, those suffering from a bad attack of the sucker present a sorry sight, the blossom clusters hanging all brown and withered on the trees. At this time also the injury to the leaves becomes apparent. These are dwarfed to a greater or less extent and paler in color than normal leaves, later turning yellow and, together with the withered blossoms, large numbers drop to the ground. The occurrence of a high wind in early July results in the ground being covered with the dead, fallen blossoms.

Injury to the foliage falls in four general categories:—

1. Brown, withered leaves that may remain clinging to the trees throughout the summer.

2. Green leaves that are sometimes shed in showers about the end of June, apparently due to sucker attack.

3. Yellow leaves which may commence falling in mid-June and continue for several weeks.

4. Similar injury to No. 3, but greatly aggravated, which seems to result from spraying infested trees with Bordeaux mixture or with copper-lime dust.

The first type of injury is common in all infested orchards, the amount present depending upon the severity of the infestation, to the care that the orchard receives, etc. The second has been noticed in some of the badly infested orchards, which exhibited a considerable drop of apparently normal leaves. The third type of injury is a frequent accompaniment of a bad attack. Its importance will vary with the number of insects present and with weather conditions, being intensified by drought. In 1919, injured trees showed a great improvement in appearance within two weeks after the disappearance of the nymphs. New leaves were rapidly pushed out to replace those injured by the insect and, except for the presence of an abundance of adults, there was little to indicate the experience through which the orchard had passed.

During the summers of 1920 and 1921, doubtless owing to the low precipitation of those seasons, the injury was more persistent and indeed was evident throughout the season in severe cases. In the unusually moist summer of 1922 the recovery from the effects of the insects' attacks was comparatively rapid.

Since the adults feed but little there is slight injury after the end of June and the trees, under favorable conditions, have an opportunity to recover, at least to a considerable extent, from the injuries of the insect. It seems reasonable to suppose, however, that early partial defoliation, particularly if repeated over a series of years, is bound to have some effect upon the crop of the subsequent season. Sufficient time has not elapsed, however, for us to have accumulated definite data on this point.

The fourth type of injury was first noted by Mr. J. P. Spittall who made some careful observations concerning it. This injury was first observed in an orchard in which nicotine sulphate had been added to the regular spray of excess lime Bordeaux, applied subsequent to the dropping of the blossom petals, in part of the orchard. In July the appearance of these two parts of the same orchard, designated "B" and "C" in the accompanying table, presented a startling contrast. The block of trees (C) which had received the treatment with nicotine sulphate were almost normal in appearance, while the foliage of that of the other block was considerably dwarfed in size, a large proportion of leaves had turned brown or yellow, the ground being already littered with many of the latter. This difference would have been attributed entirely to the beneficial effect of the nicotine sulphate on the block that had received this material, were it not for the fact that the trees of an adjoining, entirely untreated orchard, designated "A" in our table, were much healthier in appearance than those which had received excess-lime Bordeaux alone. This fact gave rise to the suspicion that the serious injury to block "B" was really a form of spray injury, aggravated by the weakened condition of the foliage, due to the insect's attack. We were strengthened in this suspicion by the fact that a similar condition was noted on a series of experimental potato plots during the season of 1920. Some had been sprayed with Bordeaux and poison, some dusted with copper-lime-arsenate dust and some sprayed with poison alone. On all the plots a serious infestation of potato aphid (*Macrosiphum solanifolii*) developed, whereupon the foliage of the plants to which Bordeaux mixture was applied, speedily withered and died. Those on the plots receiving poison alone, though suffering considerable injury from the aphis, remained green for several weeks. The foregoing facts indicate clearly that Bordeaux mixture when applied to plants, the foliage of which has been or becomes weakened by the attack of sucking insects, may suffer serious injury.

We were fortunate enough to discover two other orchards, "D" and "E", a distance of two miles from the first, suitable for further observations on this point. These two orchards, though belonging to two different owners, were, in reality, one orchard, and the conditions in each were practically identical. Orchard "D" received two applications of excess lime Bordeaux, once just before the blossoms opened and once just after the blossom petals fell. "E" received only a single application of copper-lime-arsenate dust prior to the opening of the blossoms. As the damage caused by the insects up to that time would not be very great, this orchard would be almost in the same category as an entirely untreated orchard. The results from all orchards are given in the accompanying table.

In studying this table consideration must be given to the fact that the first records were not taken until July 8th, whereas the injury began much earlier and many injured leaves had already dropped and therefore do not show in our records. As early as June 11th a considerable drop of green leaves took place in orchard "C", though little yellowing was noticed at that time.

In taking the records given in the table certain typical trees were selected and certain definite limbs on the selected trees. The total number of leaves on these limbs was then counted. Weekly countings were then made of the injured leaves as such injury became apparent. The yellowing was found to cease entirely by August 3rd.

It will be seen that in orchard "A", that received no treatment, the brown and yellowed leaves added together aggregated 16%. The adjoining orchard "B" has 36%, from which it would appear that the application of Bordeaux mixture to injured foliage tends to increase the resultant damage. In or-

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TABLE No. 1. INJURY CAUSED BY THE APPLICATION OF BORDEAUX MIXTURE TO FOLIAGE INFESTED BY THE APPLE SUCKER.

Orchard	Variety	Material Applied	Dilution	When Applied	Percentage Brown and Yellow Leaves	Average for Orchard
A	Gravenstein	No treatment.			14	
"	King.				17	16
"	Ben Davis.				16	
B	King.	1. Bordeaux and Calcium Arsenate.	6–25–100 2½–100	"Blossom pink" stage.	34	
"	King.				39	
"	Gravenstein.	2. Bordeaux and Calcium Arsenate.	6–25–100 2½–100	Just after blossoms fell.	36	
"	Gravenstein.				31	36
"	Ben Davis.				42	
C	Ben Davis	1. Bordeaux and Calcium Arsenate.	6–25–100 2½–100	"Blossom pink" stage.	14	
"	Gravenstein.				10	13
"	King.	2. Bordeaux and Calcium Arsenate and Nicotine Sulphate (40% nicotine).	5–25–100 2½–100 1 pint–100 gals.	Just after petals fell.	14	
D.	Ribston.	1. Bordeaux and Calcium Arsenate.	6–20–100 2½–100	"Blossom pink" stage.		[redacted]
		2. " "	"	Just after blossoms fell.	32	32 [redacted]
E.	Ribston.	Copper–lime–arsenate dust.	4% metallic copper.	"Blossom pink" stage.	9	
	"				12	10.5

chard "C", with an injury of only 13%, the nicotine sulphate, although not applied until after the blossom petals fell, must have reduced the injury of the insect to such an extent that serious harm was prevented. Had the spray been applied to the pre-blossom spray, it is altogether likely that the result would have been still better.

Orchard "D" again shows very plainly the effect of the spray, the average of injured leaves being three times as great as in orchard "E".

Should subsequent observations confirm conclusions indicated by the foregoing, it is a very serious feature of the insect's work. Owing to the high cost of nicotine sulphate, many growers who make spraying a part of their regular orchard practice, have not added this material to their regular sprays. As the materials most commonly used are either liquid Bordeaux or copper-lime-arsenate dust, this type of injury is likely to come much into prominence. Indeed, though the season of 1922 was not favorable to spray injury, complaints from this cause were numerous from the territory most heavily invested. It should be especially noted that none of the orchards, of which records are given, had received more than two applications. Had the full four applications been made there is a probability that the injury would have been much greater.

Life History.

Hatching.

The time of hatching of the insects from the egg has such an important bearing on control that it is here discussed somewhat fully. It is of interest to note in this connection what some of the European workers have said regarding it. Unfortunately, in some cases, the statements on this point lack definiteness and it is difficult to fix the exact period in relation to the development of the buds, which is the only method of any value on account of local and seasonal variations. Schmidberger (1840) states that the young appear simultaneously with the leaves, but that the buds are only swollen and have not "begun to sprout" when the first young appear, Kaltenbach (1874) that the nymphs appear in April and that the perfect insect occurs from the end of May until the beginning of June. It must therefore be late in April that the young appear. According to Miss Ormerod (1898), the nymphs hatch in April, boring into the buds for protection. Collinge (1905) states that hatching occurs in April. Korolkov (1914) records the fact that in the Moscow district in the preceding year, the insects emerged about the middle of April, just prior to the opening of the buds. The same writer (1915) writes that in 1914 the buds unfolded prior to hatching, enabling the young insects to get inside and rendering control difficult, a condition, by the way, which appears to be constant for Nova Scotia, in the case of most varieties. Sujatovitch-Bielikova (1914) states that in Kaluga the nymphs appeared on the 8th of May and in two or three days entered the buds, where they remained until the leaves unfolded. Lees (1917) gives possible explanations to account for the fact that the hatching of the eggs of *Psyllia mali* synchronizes with the bursting of the buds of the particular variety upon which the eggs were laid. Theobald (1909) has the following to say in regard to the matter:—

> "Another point of great interest concerning the eggs is the irregularity with which they hatch out. The date not only varies in different localities and in different years, but during the same season in the same plantation. They incubate at different periods according to the variety of apple upon which they are situated. This may be due to the heat generated by the flow of sap regulating their hatching to the time of the bursting of the buds. In 1906 they hatched out at Wye on the 10th of April on one variety of apple, on a different variety next to it not until the 20th.
>
> As much as seven days' difference was noticed at one place by Mr. Furley (at Pinvin); those on the Blenheim Orange hatched on the 3rd of April, those on the Wellington not until the 10th of April, and it was particularly noticed that they hatched first on the Ecklinville, one of the earliest of apples. Not many miles away at Eardiston they did not commence to appear until the 12th.
>
> In Kent they have been found to vary in incubation between the 24th of March and the 27th of April."

Regarding the same matter, Furley (1907) writes as follows:—

> ".....As soon as the buds commenced to swell the young "Psylla" hatched, though somewhat irregularly..... On the tips of the twigs in the photograph (Plate 3) they are clearly seen lying in wait to

enter the opening bud. Eventually they enter the buds, both leaf and blossom, but show no signs of their presence. The dates of their hatching varied somewhat this year, I found, according to the locality, and also according to the variety of tree attacked. At Pershore and Suckley the "Psylla" were hatching about April 3rd, while it was nearly ten days later before they commenced to hatch at Eardiston and Martley.

At Pinvin the "Psylla" were hatching on some Blenheim Orange trees on April 3rd, but on a few "Wellington" trees (a later apple) they did not appear till April 10th, showing clearly that there is some considerable variation in the time of hatching on the different varieties of apples, depending on their earliness or lateness. It was noticed that the young "Psylla," hatched first on the "Ecklinville Seedling", which is one of the earliest apples."

Awati (1915) states that the buds are sprouting at the time the nymphs emerge.

From the foregoing one would gather that the time of hatching of the eggs of *Psyllia mali* corresponds fairly closely to that of the eggs of *Aphis pomi* DeG. in this country, viz., at the time the buds show green at the tips, but that it may vary somewhat in either direction. It would also appear to be the general observation that the time of hatching varies with the variety of apple, depending upon its earliness or lateness, in other words, that hatching occurs on different varieties at different dates, but at the period that the buds of these varieties are in a similar state of development.

If the foregoing observations have been correctly summarized, they would not appear to agree entirely with our own observations on the hatching of the insect, made during the seasons of 1920 to 1922, inclusive. According to our records, the nymphs did not begin to hatch on the earliest opening varieties, e.g., Gravenstein, King, etc., until the leaves about the blossom clusters had commenced to open out, while the individual leaves in many of the leaf buds were showing signs of separating at the tip. On the other hand, it was noticed that on a crab tree the leaves had unfolded, the largest being one-half inch in diameter; while on a Northern Spy in the same orchard, they were scarcely beginning to show green at the tip. The buds of late varieties, therefore, such as Nonpareil, and, to a greater extent, the Northern Spy, were not so far advanced at the first hatching as were those of the earlier varieties. It was observed that as much as eleven days may elapse between the date of the first and the last hatching of nymphs on the same tree in the case of the certain varieties, but in some the period is as short as six days. The accompanying table shows the result of an experiment conducted on this point during 1921.

In general, however, it may be said that the insects appear first on the earliest opening varieties, and last on the latest opening varieties, and even on the same tree they are first found on the buds which show the greatest development, that is to say that the emergence of the nymphs does synchronize to a certain extent with a certain stage of development of the bud, but that there is a considerable varietal difference. In 1920 the first nymphs were observed on Gravenstein on May 11 and not until five days later on Northern Spy. It should be explained that the season was peculiar, in that the spring opened up late and that at the time of hatching of the insect, several days of unusually warm weather occurred.

In 1921 the spring opened unusually early and nymphs were observed hatching on May 1st on Kings, Russets and Gravensteins, and nymphs were found on all varieties of apple and pear by May 3rd. The foliage of these varieties was in the so-called "mouse-ear" stage at the time, i.e., somewhat more advanced than in the previous season, at least on the earlier varieties. The weather turned cold a few days later, the thermometer registering as low as 34°F. on May 6th and on May 10th the hills were covered with snow. Nevertheless, on May 14th the nymphs had apparently all emerged even on the Northern Spy. It may be of some value in fixing the exact period of hatching of the insect to record that the green apple aphis (*Aphis pomi* DeG.) began to hatch a week earlier and the green apple bug (*Lygus communis* Knight) just eleven days later than the first hatching of the apple sucker. In 1922 the first nymphs hatched on May 8th, but this was followed by a period of cold damp weather, which held back the hatching of the nymphs so that hatching occurred over an unusually long period.

TABLE No. 2. SHOWING NUMBERS OF NYMPHS HATCHING EACH DAY FROM DIFFERENT VARIETIES OF APPLES. 1921.

Date of Hatching.	Ben Davis	Sieck	Natural Fruit	Wellington	Stark	King	Greening	Nonpareil	Baldwin	Golden Russet	Ribston	Bishop Pippin	Northern Spy	Gravenstein	Yellow Transparen	Alexander
May 3		2	3	7	1	3	2	3	1	8	3	1	1	5	2	6
" 4		9	2	4	1	12	4	1	2	3	1	8	3	5	9	5
" 5		5	0	7	4	3	7	6	2	4	5	7	8	7	3	1
" 6	1	7	1	4	7	7	4	2	5	1	6	6	8	8	3	5
" 7	3	2	0	3	4	3	7	7	3	2	4	3	8	2	2	1
" 8	11	1	1	2	7	5	3	6	2	5	1	6	8	6	6	0
" 9	3	2	1	5	4	1	4	2	5	1	5	2	1	1	1	1
" 10	2	3	1	2	2	0	1	7	3	2	6	1	3	2	2	0
" 11	3	0	0	0	3	1	2	1	3	0	4	2	8	0	1	0
" 12	1	0	0	0	0	1	1	0	0	0	2	1	2	1	1	0
" 13	0	0	0	0	0	0	0	2	0	0	1	0	5	0	0	0
" 14	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0
" 15													1			
" 16													0			
" 17																
Total hatched	24	31	9	30	23	43	25	22	21	25	24	38	32	31	31	19
Duration of hatching period days	7	8	6	7	8	10	8	7	8	8	8	11	8	9	11	7

The manner of hatching has been described by Awati (1915) as follows:—

"The eggs are split up longitudinally. It seems that there is some mechanism, which is shared partly by the egg and partly by the larva. The spot where the larva comes out is provided with minute teeth, which form on either side a dovetailing device. At the same time the larva is provided with an egg breaker on the front of its head. The spines push the dovetailing device apart and the larva comes out. There are a number of spines both dorsally and ventrally which keep the sides of the egg apart while the larva is creeping out."

The time occupied in the process from the time the nymph began to come out until it had completely emerged in two cases noted was somewhat shorter than that observed by Awati, viz., 19 minutes in one case and 18½ minutes in another.

The appendages are at first applied closely to the body, so that it becomes necessary to free them before the insect can settle down on the bud, hence the peculiar attitude of the insect, which appears poised or balanced in the air with only its caudal extremity remaining in the cleft of the chorion. The legs, the femora of which appear at first to be glued together, gradually separate from distal extremities and become extended horizontally, a similar movement taking place in the antennæ. The insect then gradually lowers itself from its point of attachment and moves away from the shell.

The Nymphal Stage.

As is the case with related forms this insect moults five times, the duration of each instar under laboratory and under natural conditions being shown in the accompanying tables. In our experiments the duration of the nymphal stage varies from thirty-one to thirty-six days. At Wolfville in 1920 the first nymphs were found hatching out-of-doors on May 11th, at Truro May 20th. The last nymph was found at Wolfville on July 2nd, the great majority having transformed to adults several days previous to this date.

In 1921 the total duration of the nymphal stage was the same, but the first hatching took place eleven days earlier. The last nymph of the season was found on June 24th, but this was evidently a belated individual, as the majority had completed their transformations ten days prior to that date In 1922 the nymphs first appeared on May 8th and the last was noted on July 1st.

Immediately upon hatching the nymphs attempt to enter the bud, which in the case of most varieties they are able to do. Here they remain securely sheltered until the leaves have quite unfolded or the flower stalks have spread apart.

TABLE No. 3. NYMPHAL STAGES OF PSYLLIA MALI SCHMIDB. INDOOR SERIES, 1920.

No. of Insect	Date of Hatching	Number of Days Spent in each Instar					Date of Reaching Adult Stage	Duration of Nymphal Stage Days
		1st Instar	2nd Instar	3rd Instar	4th Instar	5th Instar		
1	Apr. 30	6	4	4	6	10	May 30	30
2	" 30	6	4	5	7	11	June 2	33
3	" 30	5	5	5	9	8	" 1	32
4	" 30	6	3	5	9	14	" 6	37
5	" 30	5	4	6	9	14	" 7	38
6	" 30	6	5	4	7	13	" 4	35
7	" 30	7	5	6	7	8	" 2	33
8	" 30	5	4	5	8	10	" 1	32
9	" 30	7	4	6	5	9	May 31	31
10	" 30	6	4	4	8	13	June 4	35
11	" 30	6	3	5	7	13	" 3	34
12	" 30	5	5	5	8	10	" 2	33
13	" 30	6	4	6	9	10	" 4	35
14	" 30	7	4	3	8	13	" 4	35
15	" 30	6	4	4	8	13	" 4	35
Averages..		5.93	4.13	4.86	7.66	11.26		33.86

TABLE No. 4. NYMPHAL STAGES OF PSYLLIA MALI SCHMIDB. OUTDOOR SERIES, 1920.

No. of Insect	Date of Hatching	Number of Days Spent in each Instar					Date of Reaching Adult Stage	Duration of Nymphal Stage Days
		1st Instar	2nd Instar	3rd Instar	4th Instar	5th Instar		
1	May 20	6	4	6	8	10	June 23	34
2	" 20	5	4	6	7	13	" 24	35
4	" 20	7	3	5	6	10	" 20	31
5	" 20	5	4	4	9	13	" 24	35
7	" 20	6	4	5	10	11	" 25	36
8	" 20	5	4	7	6	13	" 24	35
9	" 20	6	4	4	10	10	" 23	34
10	" 20	5	5	6	5	11	" 21	32
11	" 20	4	5	5	9	11	" 23	34
12	" 20	6	5	6	7	12	" 25	36
Averages..		5.5	4.2	5.4	7.7	11.4		34.2

The Adult.

On June 15th, 1920, the first adult was observed in the orchard at Wolfville, on June 21st and 22nd the emergence reached its maximum, the last nymph to transform being on July 2nd. The adults remain on the trees a long time before egg laying begins, many surviving several fairly heavy frosts. Though the autumn of 1919 was unusually severe, the adults were in evidence as late as early November, though their numbers decreased steadily after the middle of October. In 1920 no adults were observed in the orchard subsequent to November 12th, on which date occurred the first snow storm of the season. In the cages the last adult died on November 27th, the lowest temperature to which it had been exposed being 17°F. on November 21st.

Mating.

Schmidberger (1840) says that the adults pair and lay their eggs in September. Theobald (1909) and Furley (1907) state that pairing occurs "towards September". In

this statement they appear to be borne out by those European workers who have made any mention of this point. In Nova Scotia, however, mating occurs much earlier. Copulation was first observed during 1920 on June 29th. On July 1st, the same year, about a dozen pairs were observed in copula, and as the season advanced, it generally became more general, though on some days it seemed almost to cease entirely. On July 14th only two pairs were observed after a three hours search and the same number were seen two days later after an inspection of four hours, the weather on both days being hot and sultry. Occasionally a pair are seen to approach, momentarily join their caudal extremities and separate without completing the act. Occasional pairing was observed up to October 27th. In 1921 mating commenced on June 15th and continued almost as long as adults were left on the trees.

Methods of Control

Many remedies have been recommended for the control of the insect, some of which are set forth.

Theobald (1890) in his "Text Book of Economic Zoology" recommends paraffin emulsion against the adults to prevent oviposition and caustic winter washes to destroy the eggs. In his first and second "Report on Economic Zoology", British Museum (1903 & 1904) he also reports favorably on these methods and mentions the use of quassia and soft soap, which are not considered entirely effective. Pruning and autumnal spraying are recommended. In his "Report on Economic Zoology" for 1905, this writer records conflicting reports from the use of winter alkali washes and recommends the use of the paraffin emulsion after the fruit is picked. The impossibility of killing the young insects on account of their habit of entering the opening buds is pointed out. In his report for the following year (1906), similar advice is given. Later (1907) he described a wash of lime and salt used with success by a correspondent in spraying the eggs of this pest. Still later (1908), he again points out the difficulty of spraying for very young insects, owing to the different dates of hatching of the different varieties and that, though spraying with soft soap and quassia when the young are waiting outside the bud will destroy many, not all will be hatched. Winter washes to corrode eggs are reported as unsatisfactory, while soft soap and quassia, paraffin emulsion and tobacco wash will give results if applied just prior to blossoming. The method of autumnal spraying with paraffin emulsion is again described. In his "Insect Pests of Fruit" (1909) Theobald states that growers are wasting their time in spraying with winter washes to corrode the eggs of the insects. The only treatment found of any use in preventing the young from entering the buds, is spraying the trees with thick lime, salt and water glass mixture, the effect of which is believed to be largely mechanical, though the salt may have some osmotic power, as it was noticed that action became greater as the amount used was increased. He concludes that this method together with spraying for the adults with paraffin emulsion, constitutes the most effective remedy for the pest. In his "Text Book of Economic Zoology", second edition, (1913), the lime and salt wash applied in February is again recommended for the eggs, and tobacco wash, when the flower stalks have spread apart, for the nymphs.

Miss Ormerod (1891 & 1892) recommended jarring the adults on to a sticky surface. Schøyen (1893) states that pruning destroys many eggs and recommends petroleum emulsion as the eggs hatch, spraying for the eggs being regarded as useless. Later (1896) he writes that petroleum emulsion or even pure petroleum will not destroy the eggs, but that a carbolic and lime mixture is more effective. The former is best for spraying newly hatched nymphs, or tobacco decoction may be used. Lampa (1897) in a short account of the insect favors the use of petroleum emulsion. Shreiner (1906) records the results of experiments in the control of the pest which showed that neither a 25 per cent. petroleum emulsion, nor an exposure of 9 hours to hydrocyanic acid gas, nor 36 hours to the fumes of carbon bisulphide would destroy the eggs. He states that the only practical remedy is petroleum emulsion, three sprays being recommended, which are said to destroy seventy-five per cent. of the insects. Collinge (1905) recommends spraying in spring for newly hatched young with soft soap and for adults in fall with kerosene emulsion. Later

(1906) the use of soda and potash spray is said to be more effective the later applied. Again, (1906a), Collinge gives the formula of a special caustic winter wash, together with an itemized account of the cost of preparation, which is said to give good results. This writer regards the use of lime and salt spraying against the eggs as worthless, but reports satisfactory control (1908) from the use of "V_1 and V_2 sprayfluids". The Duke of Bedford and Mr. Spencer U. Pickering (1908) have given us the results of numerous experiments in the control of this insect. According to these tests, emulsions in which basic copper sulphate precipitated by lime, caustic soda and varying amounts of paraffin, were employed. In these preparations any increase in the amount of paraffin used appeared to increase toxicity and increasing the soda even more so. Various winter washes gave more or less killing, but the conclusion is reached that it is never possible to destroy all eggs by this method. Experiments with tobacco decoction for the nymphs are recorded, which proved more or less effective. Furley (1907), as a result of various tests, concludes that caustic soda washes, three strengths of paraffin emulsion and lime, sulphur and caustic soda wash are useless or nearly so, whereas, thick lime wash with salt gives the best, though not perfect, results. Sorauer (1913) mentions spraying for adults with petroleum emulsion, for eggs in winter with caustic alkali and lime, salt and water glass washes, also the pruning off egg-bearing twigs.

In Russia a great deal has been written regarding the control of this insect. Korolkov (1912-1913) reports the results of spraying with soft soap 1 - 3. This was effective for those nymphs which had not entered the buds, but caused some burning to the foliage. The same writer (1914a) also recommends spraying with iron sulphate on frostless days in early spring, followed by tobacco extract or green soap after eggs have hatched. He also (1914) reports the result of treatments against the eggs, using (1) carbolic acid emulsion, of which a 1 per cent. solution is believed to be satisfactory if applied a week before hatching, (2) milk of lime, which has no effect, and (3) iron sulphate, ¾ lb. in 2 gals. of water with flour paste or double the strength without flour paste, which should be applied twice. For the nymphs the best insecticides are tobacco extract and soft soap. Kerosene emulsion is cheaper, but more difficult to handle. 1 per cent. carbolic acid was considered to have given satisfactory results and can be used against eggs and larvæ. Tobacco fumigation is considered satisfactory if done by all fruitgrowers simultaneously. Still later (1915) he favors the use of the spring treatments of copper sulphate just prior to hatching, especially if flour paste is added as the best remedy.

Ol (1914) favors the use of late fall sprays of iron sulphate for the eggs, the destruction of nymphs in spring with kerosene emulsion and of the adults by tobacco fumigation. Svjatovitch-Bielikova (1914) states that control measures consist chiefly in tobacco fumigation, which was carried out over 94½ acres. Romanovsky-Romanko (1914) refers to the work of T. T. Kaike, who, in 1912, published good results obtained by fumigation with tobacco dust against *Psyllia mali* in orchards in the Government of Orel in 1910-1912. The usefulness of tobacco extract is also discussed together with economic reasons that militate against the wider use of these methods in Russia. Goriainov (1914) gives as remedies:—(1) for eggs, two applications before buds burst in the spring, 1 - 2 lbs. iron sulphate, ½ lb. rye meal or 2 - 3 spoonfuls of glue in 2¾ gals. of water, (2) for nymphs before they enter buds, quassia, kerosene emulsion, tobacco extracts, etc., (3) for adults, tobacco fumigation. Balabanov (1914) recommends lime spraying with the addition of green soap as soon as the first nymphs hatch. Orzhelsky (1914) states that in an orchard previously treated with tobacco smoke, no adults were observed during the entire autumn and only a few eggs in February and, later (1915), gives directions for applying this remedy. He states that the remedy should be applied as soon as the insects reach the adult state. The work should be done in the evening. Fumigation should begin around the periphery of the orchard, the heaps of tobacco dust at the centre being fired later. The method is reported successful in an orchard of about 30 acres. Dychov (1915) gives the following formula:

3 lbs. green soap dissolved in about 3 gals of warm water and 1½ gals. black carbolic acid added, the whole being diluted to 40 - 45 gals. with cold water. This is said to be the cheapest and most effective remedy for the eggs of *Psyllia mali* and harmless to the bark of trees. Platonov (1913) obtained excellent results from the use of tobacco extract with quassia and soft soap and later the use of tobacco smoke against the adults. Umnov (1913) reports satisfactory results from tobacco fumigation. Glasenapp (1913) describes the making of a tobacco decoction which gave good results when used during bloom. Averin (1913a) recommends tobacco extract and (1913b) lime water and iron sulphate, 3 - 5 per cent. Sudeikin (1913) suggests the use of a 3 - 5 per cent. solution of green copperas when nymphs appear, tobacco or quassia extracts, and cutting away and burning of the small branches. Rakushev (1914) obtained good results with carbolic emulsion against the young nymphs. According to Balabanov (1915), a spray of iron sulphate 1 lb. to 3 gals. of water, when most carefully used before the buds swell will only destroy from 30 to 50 per cent. of the eggs. Gohtzin (1916) records the successful use of tobacco fumigation in an orchard of twenty-four acres in which kerosene emulsion and copper sulphate with Paris green or lime had been tried without success. Dobrodeev (1914) gives directions for fumigating orchards with tobacco, which has proved more effective than the smoke from burning straw. The conditions for success in tobacco fumigation are said to be as follows:— The remedy must be applied during the preoviposition stage of the female; the smoke must be started along the borders of the orchard to prevent escape of insects; it should be done in calm weather after rain and no branches should be hanging directly over burning heaps. Pliginsky (1916) considers tobacco fumigation the most effective and cheapest remedy if carried out simultaneously in all adjoining orchards. Galkov (1916) gives details of an experiment in fumigating an orchard with tobacco for aphids and urges further experiments with smoke against psyllids and aphids.

Tullgren (1917) has reported successful results from the use of carbolineum against the eggs. In an article in the Annals of Applied Biology (1915) the use of winter or rather early spring cover washes, their effects upon the eggs with probable reasons therefor, also experiments to discover a more permanent and adhesive wash, are recorded. The effect is said to be a mechanical sealing action and not the result of chemical action. Petherbridge (1915) states that conclusions of experiments do not agree with those of observers who claim to have controlled apple sucker by spraying in early March with lime and salt, lime, salt, and water glass, or lime, salt and washing soda. The writer favors a lime, salt and sulphur wash applied as late as possible, previous to the hatching of the apple suckers. Later (1916) this worker states that the lime and salt wash prevents large numbers of eggs from hatching and that the lime wash alone is fairly effective. For the nymphs, soft soap and nicotine and treacle and nicotine were used successfully. Treatment for the eggs alone is not considered sufficient. Awati (1915) tested numerous materials against the nymphs, of which the most effective was one made according to the following formula:—

100 gals. of water,
10 lbs. of soap,
1 qt. of creosote.

Ritzema Bos (1915) gives winter spraying with carbolineum, 6 - 8 per cent., as useful against the winter eggs of *Psyllia mali*. Lees (1917) finds that a combination of bleaching powder, caustic soda and lime will not kill the eggs of *Psyllia mali* as readily as moth eggs. He also states (1917a) that the best time for lime spraying is as late as possible before the eggs hatch. He gives directions for making lime washes and states that they may be used up until blossoming, but apples are sometimes injured by late spraying. Recently (1919-1920) the writer has recorded results of preliminary experiments in spraying and dusting against this pest.

Lundblad (1920) states that the best results have been obtained in Sweden by the use of carbolineum emulsion. 10 Kg. carbolineum are pumped for about 10 minutes into a mixture of 3 Kg. of soap, dissolved in 8 - 10 litres of water. 3 Kg. of birch ashes boiled out in 10 - 15 litres of water may be substituted for the soap. When the emulsion is

sufficiently homogeneous it is thinned out in water until the spray contains 10% of carbolineum. Carbolineum must be applied just before the buds burst,—*if a month earlier it may injure the trees*. In a letter to the writer the statement that dormant spraying is more likely to prove injurious to the trees than one applied just as the buds are bursting is confirmed, which is also the opinion of Dr. Maarschalk of Holland. This worker states further that carbolineum of a fixed and definite composition is difficult to obtain, a fact confirmed by several other European entomologists. Due to this fact Lundblad concluded that carbolineum cannot be recommended in an orchard without insisting on the importance of applying it immediately prior to the bursting of the buds, at which time the trees are least susceptible.

Fryer (1921) states that control is affected by (1) semi-dormant lime wash, (2) contact sprays shortly before the blossoms open and (3) paraffin or creosote emulsion after the apples have been picked.

The foregoing, though by no means a complete statement of work done in connection with the control of the insect, gives a very fair idea of the present status of knowledge regarding this important subject, and it forms the starting point from which our own experiments have been conducted. These will be described in another article.

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Two Diseases New to Ontario.

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In the course of the writer's pathological work this summer two diseases were brought to his attention which are apparently new to Ontario, namely, Pink Root of Onions and White Rot of Grapes. Both these diseases in the opinion of the writer are of considerable economic importance and deserve the attention of Canadian phytopathologists.

In June a number of diseased onions were sent to the writer by Mr. Justus Miller, Ontario Department of Agriculture, Essex, with the statement that they had been secured from a marsh bordering on Pelee Point, and that some of the growers on this marsh stated that large patches of their onion plants lacked vigor, and were apparently affected with some kind of blight which they attributed to soil conditions. An examination of these affected plants led the writer to suspect that the trouble might be the Pink Root of Onions described in bulletin 273 of the Texas Agricultural Experiment Station. Cultures were made from the diseased plants and specimens of affected plants sent to the Bureau of Plant Industry, Washington, D.C. Pure cultures of a Fusarium were obtained from the diseased plants and a letter from Dr. W. A. Orton, Pathologist of the Bureau of Plant Industry, Washington, D.C., confirmed the opinion that the disease was the Pink Root of onions, caused by the fungus *Fusarium malli*, Taub.

Further correspondence with Mr. Justus Miller revealed the fact that Pink Root is quite prevalent in the onion growing marshes south-east of Leamington, Ontario. At least fifty acres of onions were affected by this disease this year.

The literature on Pink Root of onions indicates that the disease is widely distributed but that outside of the Bermuda onion-growing regions of Southern Texas its economic importance has not yet become generally recognized. *Fusarium malli* Taub. is a soil organism that already in Ontario has caused some loss and therefore requires immediate attention and study.

The symptoms of Pink Root as observed in Ontario are dwarfing and lack of vigor of the growing tops and dying and drying up of the roots, which usually show a faint, though fairly distinct, pink coloration.

White Rot of Grapes.

(*Coniothyrum diplodiella,* (Speg) Sacc.)

This disease was first observed by the writer in a vineyard near Winona, Ontario. It was later noticed near St. Catharines. The literature on the White Rot of Grapes would indicate that in North America it is usually considered a disease of only secondary economic importance. Observations made in two vineyards in the Niagara district this year prove that white rot may cause very serious damage to certain commercial varieties of grapes. The variety which appeared to be most susceptible was Agawam or Rogers No. 15. Unsprayed rows of this variety have over 80% of the bunches affected and unfit for market.

White Rot of Grapes at first glance is easily mistaken for black rot. A little careful observation however, soon makes apparent the distinctive symptoms of white rot The most striking symptom is the wilting of the berries which at first show no sign of discoloration, rotting or fungus parasite. If the pedicels on these berries are examined brown lesions will be seen upon them. Sometimes the whole pedicel is brown and shrunken. In the brown areas on the pedicels the pycnidia of the fungus may sometimes be observed. The disease apparently always shows on the pedicels first. Later affected berries develop brown lesions, shrivel up and become covered with light brown pycnidia. These brown pycnidia and the ovoid to elliptic, faintly smoky spores that they contain make it easy to distinguish the pathogene from *Guignardia bidwellii* (Ellis,) Viala and Ravaz.

One year's experiments would indicate that White Rot even on very susceptible varieties is readily prevented by spraying with Bordeaux mixture as recommended for Black Rot.

Fungicides.

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One of the fundamental problems of plant pathology is that of immunity and resistance to disease. It is well known that even species which are closely allied botanically show great differences in their susceptibilities to parasitic diseases. One species may be susceptible and a closely allied one immune. Within the limits of the same species there are often great differences in susceptibility between different varieties or strains. This knowledge is made practical use of by the grower in selecting varieties suitable for his conditions, and by the plant breeder in developing improved strains. We are, however, in almost complete ignorance of the underlying mechanism which governs the phenomena of immunity and resistance in plants. What little experimental work that has been done indicates that infection is the result of chemotropism, and that resistance is determined more by biochemical factors, e.g. the constitution of the protoplasm and cell sap than by histological ones such as protective cuticle and bark, though these may have protective value.

In the study of immunity and resistance amongst animals a considerable body of knowledge has been collected and the results are made of practical value by the preparation of antitoxic sera, vaccines, etc. The organisation of the higher plant being relatively simpler than that of the higher animal and there being nothing in the plant corresponding to the blood, the investigation of these phenomena amongst plants is more difficult. Moreover, in any case, it does not promise the same practical results. Even if it were found possible to develop preparations corresponding to the antitoxic sera now so extensively used in combatting disease amongst animals, their use would offer difficulties. There is no genuine circulatory system in plants and fluid material injected at one point of the root system may be traced in a more or less straight line up the trunk into the branch immediately above the point at which it was introduced. It has not been generally diffused throughout the body. Moreover, the cost of such treatment would, in all probability, be prohibitive except in the case of valuable trees. An attempt has been made in certain cases to increase the resistance of the plant tissues to specific organisms by feeding chemicals in solution to the roots, but in only a few cases have favorable results been obtained. It is claimed that the application of ferrous sulphate to the soil has enabled fruit trees affected with silver leaf to overcome the parasitism of *Stereum purpureum*, the causal fungus. As, however, there are silver leaf conditions almost indistinguishable from that due to this pathogen but apparently nonparasitic in origin, the evidence is not absolutely conclusive. Since, then, we have, apparently, little promise of being able to fight parasitic diseases from the inside, other than by following those horticultural or agricultural practices which contribute to the health and vigor of the crops; we are compelled to fall back on external protective measures. One of the most important of these is the use of a fungicide applied in such a way that it forms a lasting protective coating for the external surface of the plant, and prevents the entrance of the parasite into the tissues. Fungicides are entirely preventive. Except in one or two cases, e.g. powdery mildew, where the parasite is superficial, and does not invade the internal tissues, it is impossible to check, by a fungicide, the further development of an organism that has produced infection. Moreover, a fungicide has to be such in the strict sense of the word, i.e. it must kill or at least inhibit the growth of the fungus spore or other form of the parasite. An entomologist may use a repellent to drive a pest from his crop to that of his unfortunate neighbors but the plant pathologist has no such resource.

It is a noteworthy fact that both of the groups of fungicides in general use, viz., those with copper sulphate as a basis such as Bordeaux mixture, Burgundy mixture, and ammoniacal copper carbonate, and the lime-sulphurs are the results of accidental discoveries. There has been little attempt made

to test out systematically the toxic value of the great number of available chemicals, inorganic and organic, on the various plant pathogens.

It would seem that investigation along these lines might be profitably undertaken with a number of our most serious disease-producing organisms, and it would seem something of a reproach to plant pathologists that more has not been attempted. At the same time it must be rememberd that toxicity to the parasite is only one essential in a fungicide. In addition it must be capable of being applied in a form non-injurious to the crop plant, adhesive and not easily washed off by rain, easy of preparation and cheap. Moreover, the economics of crop production do not as a rule permit of specific applications for each disease which may threaten a crop but a fungicide of somewhat general utility is usually desirable. The copper and the lime sulphur fungicides meet these requirements and when we consider that copper is so powerful a fungicide that 1 part of $CuSO_4$ in a million of water is effective against certain serious plant parasites, there would seem to be a certain amount of excuse for the presumed apathy of the plant pathologist in the search for new fungicides. In any case this systematic search could not be followed successfully by the ordinary plant pathologist whose concentration is distracted by a multitude of calls for assistance of an immediately practical kind and covering a diversity of problems. To ask him to undertake a solution of fundamental problems is pretty much like asking the general medical practitioner to undertake such a subject as cancer research.

From what has been said it will be understood why most experimental work on fungicides has been a matter of modifying existing formulas to meet special requirements, and improving the methods of application. While such experimental work is not of a fundamental character and does not promise to revolutionise our methods it is of great practical importance and its results are often quickly available for the help of the perplexed grower. For instance in this Province we have recently developed modifications of our standard copper fungicides in respect to strengths and times of application which practically ensure control of apple tree Anthracnose under almost all conditions. We have also tested out fairly thoroughly the modified Bordeaux mixture, with large excess of lime, which apparently has become so popular in Nova Scotia. It is interesting to note that, while under certain local conditions in British Columbia, we may get better results where this fungicide is used, such results are not likely to be general and there is little liklihood of this fungicide superseding lime sulphur as it is said to have done in Nova Scotia. Our results in this emphasize the necessity of testing out, under our own conditions, findings apparently well established elsewhere. Probably the most important innovation, or perhaps we should say re-discovery, of recent years in respect to fungicides is in the method of application, the use of the dry material in powder form being substituted for the liquid spray. In this also we have done a certain amount of experimental work with results somewhat different from those obtained elsewhere. We have, for instance, found under West Kootenay conditions that finely divided sulphur dust, used alone, was of little value in the control of apple scab during three seasons' tests. This may be due to the fact that under the conditions of the test the addition of lead arsenate was not called for to combat insect pests and there may consequently have been a loss of adhesiveness. Much more promising results have been obtained with the dry Bordeaux mixture made with dehydrated copper sulphate and commonly known as Sanders' Copper Dust. While it has not given as good control of apple scab under Kootenay Lake conditions as either liquid Bordeaux or liquid lime sulphur, still the resulting crop was fairly clean, the cost much the same and the rapidity of application much greater. So far as fungous diseases are concerned, it is quite likely that dusting could replace spraying with advantage and convenience to the grower. So far as I can see the limiting factor to its general application at present is the control of certain sucking insects. So long as a liquid spray is necessary for this purpose, so long will dusting remain of secondary importance since it is only the large grower that can afford to invest in two sets of machinery for the control of pests and diseases.

Sechage des Plantes pour Herbiers.

PAR P. FONTANEL, S.J.

Collége de l'Immaculée-Conception, Montréal, P.Q.

(Suite du numero de décembre)

II.—Résultats.

Le meilleur moyen de connaître la supériorité d'une méthode de séchage sur l'autre était d'employer simultanément les deux méthodes, de cueillir toujours les deux échantillons dans les mêmes circonstances et de les maintenir, après séchage, dans des conditions identiques: la comparaison devenait ainsi automatique.

J'ai signalé déjà un avantage du procédé que j'appelle intermédiaire: sans le moindre ennui préparer autant de plantes qu'on veut, en quelques heures. Au point de vue conservation et beauté, je vais indiquer les principaux groupes à faire, en donnant pour chacun quelques exemples pris parmi les plantes communes des champs ou d'appartement. Je mets le nom officiel entre parenthèses, pour satisfaire à la précision requise par les amateurs qui voudraient vérifier.

1°. Les plantes cueillies mouillées ou trop jeunes et trop tendres se conservent mal; elles ternissent fortement même en séchant. Il n'y a aucune différence avec les méthodes; v. g. Trèfle rouge (Trifolium pratense L.) Cependant la règle n'est pas absolument générale: ainsi, les Narcisses cueillis mouillés se conservent parfaitement (v. g. Narcissus poeticus L.); d'autres plantes, jeunes et tendres, font aussi exception; telles les Prêles (Equisetum arvense L., E. uliginosum Willd.), la Rhubarbe (Rheum rhaponticum L.), l'Ansérine (Chenepodium album Moq.)

2°Même coupées dans de bonnes conditions, sèches, ni trop jeunes, ni trop, vieilles, quelques espèces donnent des résultats identiques avec des procédés différents, v. g. Astère (Aster L. sp.), Tilleul (Tilia Canadensis Michx.), Epine-vinette (Berberis vulgaris L.), Mélèze (Larix Americana Michx.), Trèfle incarnat (Trifolium incarnatum L.) Framboisier (Rubus saxatilis Michx., R. strigosus Marsh.), Lilas (Syringa vulgaris L.), Pourpier (Portulaca oleracea L., P. grandiflora Lindl.), Tabac (Nicotiana tabacum L.), Iris (Iris versicolor L.), Bourse à pasteur (Capsella bursa pastoris Moench.) Asclépiade (Asclepias Cornuti Deene.) Immortelles des jardins, Pétunias d'ornement. Verveines, Zinnias d'ornement, Carex Capucines, Plantains (Plantago major L.; P. lanceolata L.), Liseron (Convolvulus arvensis L.) Belle-de-nuit (Mirabilis Jalapa L.), Airelle (Vaccinium Canadense Kalm.).

Onne s'etonnera pas de trouver dans coite catégorie les Immortelles qui doivent précisément leur nom à leur inaltérabilité: elles se conservent des années avec leur fraîcheur naturelle et gardent leurs teintes les plus délicates si on les fait sécher dans l'obscurité.

3°. Pour d'autres, sans être nulle, la différence est faible: v. g. Linnée (Linnæa borealis Gronov.), Cèdre (Thuya occidentalis L.) Mélilot (Melilotus albus Lam., M. officinalis Willd.), Achillée (Achillea ptarmica L.), Amaranthe (Amaranthus caudatus, A. tricolor L., A. paniculatus L.), Violettes (toutes les espèces indigênes), Diclytrie (Corydalis Canadensis Goldie, C. formosa Pursh.).

Les groupes précédents se rapportent à la conduite des plantes pendant le séchage; ceux qui suivent, a leur conduite apres le séchage.

4°. Beaucoup de plantes, plus belles par séchage accéléré, s'altè rent si on ne prend pas la précaution de les protéger contre l'air: v. g. Pâquerettes (Bellis sp.), Groseilliers (Grosularia D. C. sp.) Julienne (Hesperis hortorum L.), Cerisier de Virginie (Prunus Virginiana L.).

L'altération consiste à prendre les couleurs de celles préparées par les anciens procédés. La modification se fait lentement; elle est généralement complète après cinq à six mois.

5°. D'autres s'altèrent même si on les traite avec soin. C'est généralement le cas pour les plantes à suc fortement sapide, ce qui s'explique facilement par les réactions chimiques; v. g. Oseille (Rumex acetosella L.), Oxalis (Oxalis acetosella L., O. stricta L.), Cicutaire (Cicutaria maculata Lam.)

6°. Parfois les *feuilles* se conservent plus fraiches, tandis que les *fleurs* ont à peu près les mêmes teintes avec les deux procédés, v. g. Stellaires, surtout la Stellaire à longs pédicelles (Stellaria ovalifolia Hook.), Cerisier (Cerasus J. sp.), Gaillarde, Sceau de Salomon (Polygonatum multiflorum Desf.), Muguet (Convallaria borealis L.)

7°. Parfois les *fleurs* se conservent mieux après séchage rapide, tandis que les *feuilles* prennent les tons des plantes séchées à l'antique: v. g. Chataire (Nepeta glecoma Benth.), Pomacées (surtout Malus J.), Prunier (Prunus L.), Chicorée (Cichorium intibus L.), Muflier (Anthirrinum majus L. et espèces ornementales), Geraniums (Pelargoniu n zonale Willd., P. inquinans Ait.), Sarrazin (Fagopyrum esculentum Moench.), OEillets (Dianthus barbatus L., D. plumarius L., D. superbus L.), Marguerite blanche (Chrysanthemum leucanthemum L.), Moutarde (Sinapis arvensis L.), Boule de neige (Virburnus sterilis), Malope (Malopa grandiflora Car.), Phlox (Phlox Canadensis Sweet., P. Drummondii Hook.), Reine-Marguerite.

8°. Enfin, la plus grande partie se conserve plus belle, même si on ne lui prodigue pas de soins particuliers aprés le séchage. Voici quelques exemples pris parmi des millers: Gadelier (Ribesia rubra (L.) Prov.), Pensées Viola tricolor L.) Mil. (Phleum pratense L.), Vulpin (Alopecurus geniculatus L.), Roses-Bardane (Lappa major Gaert.), Renouée (Polygonum aviculare L., P. persicaria L.), Vesce (Vicia hirsuta Koch., V. sativa L., V. cracca L.), à peu près toutes les Graminées—Aubépine (Crategus sp.), Orme, Spirée, Aurine .

Il serait intéressant de chercher les causes des altérations soit pendant, soit après le séchage. C'est surtout une question de chimie biologique, trop théorique pour le but essentiellement pratique de cette étude. Je me propose de la discuter prochainement à un autre point de vue, celui de la taxonomie et de la variabilité de l'espèce.

"Le Nationaliste Canadien"

Chez Nos Amis de Québec.

Le président de la section locale de Québec a adressé à tous ces confrères de la région la lettre suivante qui est un beau et solide plaidoyer pour l'association. Nous souhaitons qu'elle porte tous ses fruits:

Messieurs et chers confrères:

La dernière convention des Agriculteurs Technologistes, tenue au Collèege Macdonald, du 26 juin au 1er juillet courant, a déterminé dans notre Association un élan nouveau d'activité et d'enthousiasme qui portera des fruits heureux pour chacun de nos membres.

La Société des Techniciens Agricoles est en mesure d'aider chacun de ses membres à réaliser la plénitude de ses ambitions professionnelles. Pour cela, elle demande à chacun de nous quatre choses indispensables:

1o—Que chaque membre se fasse un orgueil d'appartenir à l'association et ne craigne d'en parler.

2o—Que chaque membre mette en jeu tous ses talents pour donner à son travail le maximum d'efficacité; notre corps social n'aura d'authorité qu'en proportion de la valeur personnelle de ses membres.

3o—Que chaque membre lise la "Revue Agronomique" chaque mois, qu'il prenne connaissance des avis et articles de collaboration; et que chacun se fasse un devoir de donner son article au moins une fois par année.

4o—Que chaque membre soit convaincu que la contribution annuelle payée n'est pas de l'argent perdu. Et désormais il est établi que cette contribution sera de $6.00 pour les anciens et de $10.00 pour les membres nouveaux.

Notre secrétaire de section, M. J. B. Cloutier, B.S.A., dont le bureau reste au Ministère de l'Agriculture, Hôtel du Government, Québec, prie les confrères de remarquer que la contribution annuelle sera payable au 1er juin de chaque année.

Nous prions, avec instance, nos confrères anciens et nouveaux, de croire en leur association, et de se bien persuader qu'elle n'aura de force qu'en autant que chacun y mettra sa confiance et sa ferme volonté.

Agréez l'assurance de mon entier dévouement.

J. B. Cloutier, Secrétaire.

A. Désilets,

Président de la Section de Québec.

Concerning the C.S.T.A.

The General Secretary was able to visit local branches in the prairie provinces during November. Leaving Ottawa on November 7th, meetings were attended at the following points:

Winnipeg—Thursday, November 9th
Regina—Friday, November 10th.
Saskatoon—Saturday, November 11th.
Edmonton—Monday, November 13th.

The Presidents of these branches presided at the meetings and the attendance of members was excellent. On November 14th and 15th, in company with Mr. D. H. Galbraith, M.L.A., and President Tory of the University of Alberta, a visit was made to the Experimental Farm at Lethbridge and the Agricultural School at Raymond, Alberta.

In all his addresses, the General Secretary outlined the progress made between June 1920, when the Organizing Convention was held at Ottawa, and June, 1922, when the second Annual Convention was held at Macdonald College. This outline included:

1. The enrolment of six hundred members
2. The organization of thirteen local branches.
3. The work of standing Committees on:
   a. Educational Policies.
   b. Research.
   c. Marketing Education.
   d. Graduate Studies.
4. The establishment of the Bureau of Records.
5. The establishment of an Agricultural Text Book Club.
6. The development of *Scientific Agriculture* until it became self-supporting under Society ownership,
7. The contact established between technical workers in Canada and co-workers in the United States, Europe, Australasia, Russia, South Africa, India, China, Japan and Mesopotamia.
8. The holding of annual Conventions.
9. The holding of local branch meetings.

This outline was followed by a more detailed statement of the work now in progres

The magazine was discussed at som length, with special reference to the editori and advertising policies.

The difficulty of keeping the Society o a safe financial basis was emphasized. A though the magazine was self-supporting, should not be expected to bear any of th Society's operating expenses. These shou be covered by the membership fee, and th $6.00 fee was just about sufficient for tha purpose, *if paid promptly.*

There was also need for an organize membership campaign, which would prob ably be undertaken immediately from the cen tral office.

A plea was made for individual suppo to the local branch and to the parent Soc iety, and the fullest possible co-operation i the tasks which the Society had yet to un dertake.

There was no suggestion of criticism a any of the four meetings, and there appear ed to be every prospect of local activity dur ing the coming winter.

At the Saskatoon meeting it was decided that the dates for the next Annual Conven tion, to be held there, would be June 20th 23rd, 1923, inclusive.

RETROSPECT.

Since the early part of 1920, now three years ago, when the Society was organized it has come through a series of obstacles and set-backs which seemed at times to be un surmountable. Such periods of depressio occurred at frequent intervals without ap parent cause. The organization was so wide spread, its activities so varied, its member ship so large, that it was difficult to trace the origin of a situation or to attempt to remedy it.

Organization among technical agricultur ists was a new idea and it was but natural for the individual attitude of many to be one of skepticism. There was a prevalen

opinion abroad for instance, that the C.S.T.A. was an outgrowth of Civil Service reclassification and that it was organized chiefly to assist in obtaining higher salaries for its members. Some joined for that reason, while others stayed out for the same reason. As the organization developed its objects became more fully understood and appreciated. It was plain that the platform upon which the Society stood was one of broad principles, that it was attempting to secure recognition of the agricultural profession by the Canadian public, and to give world-wide publicity to the work being done in Canada, to assist in formulating uniform policies, to raise the status and standard of the profession, and to do similar work of national importance. Along those lines it is still working and will continue to work.

The Canadian Society of Technical Agriculturists is not an organization from which any member should expect to obtain personal benefit. At the same time it is expected that every one who is eligible for membership is proud of his profession and anxious to assist its advancement. That is the function of national organizations,—but national organizations are not possible without a large, representative membership list and the individual support and interest of every member.

The C.S.T.A. has come through its pioneer stages, and the credit for that can be shared by all those who have been in any way associated with it during the past three years. The detailed history of that period may never be known and certainly will never be fully appreciated. But, considering the obstacles that have had to be overcome, its progress has been phenomenal. Not only has it completed its organization work and established an official organ under its own ownership, but it has also undertaken many other activities which have suggested themselves from time to time. The meetings of local branches, the holding of annual Conventions, the Bureau of Records, the Text Book Club, the establishment of scholarships, the forming of affiliations, the work of Committees, and many other activities all suggest the possibilities for development and expansion.

The Society now enters upon a new era, a period of progress. There is no similar organization in Canada. It is entitled to the support of every eligible member, and it must have that support. Professional pride must be stimulated, the membership must increase, developments must take place in many directions, and whole-hearted co-operation must be given by every member.

New obstacles will present themselves. They add zest to the undertaking and progress would be dull without them. The C.S.T.A., as a national institution, must be creditable to the profession it represents; it therefore expects, and deserves, the support of those who are able to join its ranks and assist in its development.

Three years are past. The danger period is behind. The future is what we make it.

C.S.T.A. BOOKLET.

In order to maintain member interest and to assist in securing new members, the General Secretary intends to proceed immediately with the preparation of a special booklet. In addition to an up-to-date list of members and the revised Constitution and By-laws, the booklet will contain a complete history of the Society from its inception three years ago, and a full outline of its present activities.

The booklet will probably be printed in February and will be given very wide distribution. Suggestions from members which will help to make such a booklet most effective will be appreciated.

UNITED MARITIME BRANCHES

On the evening of Wednesday, December 15th, fifty members of the three Maritime Branches met at the Amherst Winter Fair. Dr. M. Cumming, Principal of the Nova Scotia Agricultural College, presided. A banquet was served at seven o'clock, following which addresses were given by the General Secretary and by Dr. James W. Robertson of Ottawa. Particular emphasis was placed on the importance of developing professional pride and of doing something for Canada apart from work for which financial reward was to be expected. By giving their support to the C.S.T.A. the members indicated a pride in their profession. An eligible member who did not join the Society was not only retarding its development but was bringing upon himself the criticism that

his attitude towards his own profession was narrow and selfish.

Following these two addresses brief speeches were made by L. H. Newman, Secretary of the Canadian Seed Growers' Association and Honorary Secretary of the C.S.T.A.; W. J. Reid, Secretary of the Prince Edward Island local; J. H. King, President of the New Brunswick local; W. H. Brittain of the Nova Scotia local and W. H. J. Tisdale of the Western Ontario local. The meeting was then thrown open for general discussion.

The enthusiasm which pervaded the meeting was very gratifying and it is unfortunate that the spirit of such a gathering could not be carried to those members who have shown, and continue to show, apathy towards the Society and who doubt its future usefulness.

It was agreed that a similar joint meeting of the three Maritime branches should be held each year at the time of the Amherst Winter Fair. With this object in view Mr. E. F. Pineau of Moncton, N.B., was appointed to arrange necessary details. Much of the success of the meeting on December 13th. was due to the efforts of Mr. Pineau, to whom an enthusiastic vote of appreciation was tendered.

EASTERN ONTARIO

The first of a series of monthly meetings was held at the University Club, Ottawa, on December 15th. Mr. J. A. Ruddick presided and forty members were present.

Following a banquet, an address was given by the Hon. W. R. Motherwell, who emphasized the growing importance of the agricultural "expert," and traced that development during the past forty years. He expressed the opinion that the solution of present low returns on Canadian farms and of the high cost of living, must lie in increasing farm production per acre through improved methods. In that work the technical agriculturist was vital.

MACDONALD COLLEGE.

A tentative programme has been received, providing for a Convention of this local at Macdonald College on February 1st and 2nd. A special effort is being made to make the programme of interest to Quebec farmers, and many invitations will be sent out. It is felt that in this way the work of the Society will become better known throu the Province.

Among the subjects which will be duced at the meeting and fully dis are the following:

1. Agricultural Research and the fa
   (a) How agricultural researc ves the farmer.
   (b) Agricultural research nee Quebec.
   (c) The more important lines perimental work.
2. Agricultural Educational Policie
   (a) Courses in agricultural in tion.
   (b) Present day needs in agric al education.
   (c) The winter course in agricu
3. Agricultural Extension Work:
   (a) The C.S.T.A. and the farm
   (b) What the Quebec farmers
   (c) Agricultural Extension Ager
4. Extension Projects:
   (a) Farmers' Organizations.
   (b) Farm Projects.

NORTHERN SASKATCHEWAN

A banquet and social evening was hel the University of Saskatchewan, under auspices of the C.S.T.A. on December L. S. Klinck, first President of the C.S.T was present and outlined the aims of Society.

A visit was paid to the Laboratory and M eum of the Field Husbandry Department examine a specially arranged exhibit. L in the evening a social hour was spent. ies were invited.

APPLICATIONS FOR MEMBERSHIP

F. S. Browne (McGill '12, B.S.A.) perimental Farm, Lennoxville, P.Q.

C. H. Goulden (Saskatchewan, 1921, A.) University of Saskatchewan, Saskato

S. J. Hetherington (McGill, 1921, B.S. Dept. of Agriculture, Regina, Sask.

C. H. Lee, (Toronto, 1896, M.A.) Ac Principal, Manitoba Agricultural Coll Winnipeg.

S. G. Lochhead (McGill & Leipsic, M.Sc., Ph. D.) University of Alberta, Edm ton.

Trueman Stevenson, University of S atchewan, Saskatoon. (Associate)

J. W. Thompson (Toronto, 1922, B.S Collegiate Institute, Saskatoon.

Economic Factors in Fattening Chickens

BY M. A. JULL and W. A. MAW,

Department of Poultry Husbandry, Macdonald College, P.Q.

In the raising of chickens, whether under ordinary farm or more strictly commercial conditions, there is always a high proportion other than those used for breeding purposes for which it is necessary to develop the most economical means in preparing for market. The demand for chicken meat as an article of diet has been increasing steadily during recent years and this increase would be augmented considerably by a still further improvement in the quality of the meat. The quality is improved best by fattening, which is a finishing process involving a replacement of much of the water in the flesh by oil so that when the chicken is cooked the meat is tender and juicy. Improvement in quality is not only the best means of giving rise to an increased consumption but will also lead to higher prices being paid for the finished product.

The Objects of the Experiment.

Fundamentally, the objects of the experiment involved a determination of the most economical means of fattening chickens from the standpoint of size of stock, length of fattening period and kind of ration. With these objects in view, the Department of Poultry Husbandry of Macdonald College, during the past seven years, has conducted a series of experiments, the results of which should be of interest to the poultry industry. A portion of the results have been discussed previously by the junior author (1), but in a different form from the financial aspect. It should be remarked that the actual fattening work was carried out almost exclusively by the junior author and the fact that most of the work was done by the same party doubtless has contributed much toward securing uniform results.

(1) Maw, W.A., 1921, Experimental Results in Fattening Poultry, Jour. Amer. Assn. Inst. and Invest. in Poultry Husb., Vol. VII, No. 6.

Methods.

All of the chickens used were of bred-to-lay strains of Barred Plymouth Rocks and Rhode Island Reds and particular care was exercised in the selection of stock suitable for fattening purposes. Most of this work was done on the basis of lots consisting of six chickens each. From the standpoint of size two groups of chickens were used, a group of large-sized chickens approximating an average of four pounds each and a group of medium-sized chickens approximating an average weight of three pounds each. This division in weight seems justified in view of the possibility of marketing chickens relatively early in the season when prices for well fattened chickens are usually somewhat higher than during the Thanksgiving and Christmas seasons, when the chickens are practically mature.

Both groups of chickens were fattened for ten day, two week and three week periods.

The rations used are shown in tabular form, the figures representing percentages and the plus and minus signs indicating whether sour skimmilk or water was used to moisten the ration.

All weighings were made as carefully as possible, the first weighing being done on the morning of the day beginning the test and the final weighing being done approximately twelve hours after the final feeding.

Fattening crates, each divided into three sections, were used and care was taken not to have the birds overcrowded.

The chickens were fed three times daily, regularity always being kept in mind. During the first few days of each fattening period the amount of feed given was restricted but was increased gradually as the period advanced so that during the latter part of the period the chickens were given all they would eat. Each feeding was prepared approximately twelve hours in advance of being fed. In those rations in which milk was

THE RATIONS USED

Ration	I	II	III	IV	V	VI	VII	V
Oatmeal	33.33	30.00	33.33	30.00	26.66	36.00	32.00	36
Cornmeal	33.33	30.00	33.33	30.00	26.66	36.00	32.00	36
Buckwheat	33.33	30.00	33.33	30.00	26.66	—	—	-
Middlings	—	—	—	—	—	18.00	16.00	18
Beef Scraps	—	10.00	—	10.00	20.00	10.00	20.00	5
Milkstock	—	—	—	—	—	—	—	5
Skimmilk	—	—	+	+	+	+	+	-
Water	+	+	—	—	—	—	—	-

used, it was not made a definite percentage of the ration but only a sufficient quantity was used daily to make the ration of such a consistency as would allow of easy pouring from the feeding pail.

Prices.

A word of explanation is necessary respecting the financial interpretation of the results of this experiment. The authors appreciate the difficulties involved in discussing experimental results purely from the financial standpoint and have purposely avoided interpreting the results in terms of net profits. The object has been rather to determine results which might indicate the more profitable size of stock to fatten, the most profitable length of period to fatten, and the most profitable kind of ration for fattening purposes. No attempt has been made to consider the proper amount of overhead charges because in an experiment involving a limited number of chickens it is practically impossible to arrive at a fair value which could be applied to commercial conditions. Moreover, the amount of overhead charges would be determined very largely by local conditions and in any given circumstances would constitute a stable factor. The amount of labor involved in the experiment has not been taken into consideration, because it was practically impossible to compute the actual amount of labor and, moreover, the number of weighings made necessary with the limited numbers of chickens would not justify drawing conclusions in respect to labor income in ordinary fattening work.

The only prices taken into consideration are those of the feeds used and those of live unfattened and live fattened chickens. It is well known, of course, that all these prices vary from year to year and, in fact, throughout the season in any one year. the other hand, for the purpose of this periment it is perfectly legitimate to emp prevailing prices of the feeds and the unfattened and fattened chickens. In res to a comparison of four different rati the principal feature of this experiment had to do chiefly with a comparison of n and beef scraps and different amounts beef scraps. The prices used are those p vailing during the fall of 1922.

The feed prices per ton are as follo cornmeal, $34.00; oatmeal, $35.00; m dlings, $27.25; buckwheat, $41.00; b scraps, $105.00; milkstock, $100.00; ski milk, $8.80. The prices per 100 pou for the rations given in Table 1 are as f lows: Ration I, $1.83; Ration II, $2.1 Ration III, $1.83; Ration IV, $2.18; Rati V, $2.52; Ration VI, $2.01; Ration V $2.38; Ration VIII, $2.00. Live unfatten chickens are valued at 18c per pound a live fattened chickens at 23 per pound.

It should be remarked that the spread five cents per pound between live unfatten and live fattened chickens is the prevaili difference on many markets. The amou of spread is always determined, of cours by the actual condition of the fattened chic ens at the time they are offered for marke A Barred Plymouth Rock or Rhode Islan Red chicken weighing approximately thre pounds at the commencement of the fattenin period is immature and although it will in crease in weight may not fatten to such state as to be plump. Such a chicken woul not command as high a price as a chicke which weighed four pounds at the commence ment of the fattening period and whic would, therefore, be much plumper when fa tened. On the other hand, the price of mar ket poultry is considerably higher at th

Table I Showing the Comparative Results of Large-sized and Medium-sized Chickens for the Three Fattening Periods with Rations III, VI and VII.

Period	Size	Ave. Wt. lbs.	No. Birds	No. Lots	Basis of Comparison	Unfattened	Fattened	Percentage Gain	Ration Consumed	Milk Consumed	Percentage Gross Revenue on Cost
Three Weeks	Large	4.44	87	14	Wt. in lbs.	386.50	504.06	30.42	543.75	751.48	138.19
					Value in $	69.56	115.93	66.66	11.03	3.30	
	Medium	3.06	94	15	Wt. in lbs.	288.01	390.25	35.50	434.50	628.25	142.07
					Value in $	51.83	89.75	73.16	8.57	2.77	
Two Weeks	Large	4.19	189	30	Wt. in lbs.	792.75	1011.06	27.54	772.50	1112.48	140.82
					Value in $	142.68	232.55	62.99	17.57	4.83	
	Medium	2.87	151	23	Wt. in lbs.	434.75	578.00	32.95	496.00	803.99	145.42
					Value in $	78.24	132.93	69.90	9.63	3.54	
Ten Day	Large	4.41	66	11	Wt. in lbs.	291.25	359.00	23.26	196.50	288.19	142.76
					Value in $	52.41	82.56	57.53	4.16	1.26	
	Medium	2.76	84	14	Wt. in lbs.	232.06	287.25	23.78	188.25	371.44	139.60
					Value in $	41.77	66.06	58.15	3.92	1.63	

season of the year when the growing chickens average about three pounds each at the commencement of the fattening period. As a matter of fact, the advantage in the matter of price would probably rest with the younger chickens, but in this experiment all the chickens are valued at the same prices for unfattened and fattened stock respectively.

Results.

The results of this experiment are expressed in the tables in terms of the "Percentage Gross Revenue on Cost," the cost factor including the cost of the unfattened chickens and the cost of the feed and milk used. The percentage gain is also given in the tables, both in respect to gain in weight and gain in value .

The results dealing with the more profitable size of chicken for fattening purposes are shown in Table I. Rations III, VI and VII were used throughout and the results are shown separately for each period. Considering the factor of the percentage gross revenue on cost, it will be seen that for the three and two week periods the medium-sized chickens gave better results than the large-sized chickens but that for the ten day period the reverse was the case. The best results were secured with medium-sized chickens fattened for two weeks. The results with medium-sized chickens fattened three weeks and large-sized chickens fattened ten days are practically the same. There is very little difference in the results with medium-sized chickens fattened for ten days and large-sized chickens fattened for two and three weeks respectively. These results seem to show that the more profitable size of chickens is the medium-sized chicken when fattened two weeks or a large-sized chicken when fattened ten days. It would seem that the size of the chicken determines, to some extent, at least, the length of time it should be fattened.

The most profitable length of time to fatten chickens averaging four pounds each is shown in Table II. It has been suggested, based on the results shown in Table I, that large-sized chickens should be fattened ten days and this is borne out in Table II, the results shown therein being obtained with Rations III, VI, VII and VIII. The most

Table II Showing the Comparative Results of the Three Fattening Periods with Large-sized Chickens with Rations III, VI, VII and VIII.

Period	Ave. Wt. lbs.	No. Birds	No. Lots	Basis of Comparison	Unfattened	Fattened	Percentage Gain	Ration Consumed	Milk Consumed	Percentage Gross Revenue on Cost
Three Weeks	4.33	105	17	Wt. in lbs.	454.75	596.06	31.07	653.75	751.48	139.36
				Value in $	81.84	137.09	67.51	13.23	3.30	
Two Weeks	4.14	225	36	Wt. in lbs.	932.50	1195.56	28.21	917.50	1112.48	142.33
				Value in $	167.83	274.98	63.84	20.47	4.89	
Ten Days	4.43	84	14	Wt. in lbs.	372.50	460.25	23.56	260.50	288.19	143.56
				Value in $	67.03	105.85	57.91	5.44	1.26	

profitable gain was made in the ten day period and when it is realized that the value of the extra labor required for the two and three week periods respectively over the ten day period is not taken into consideration the difference in favour of the ten day period is greater than that actually shown. It is apparent, then, that chickens averaging four pounds each should be fattened for about ten days.

A different situation is shown to exist in connection with chickens averaging three pounds each. In this case, as shown in Table III, where Rations III, IV, VI and VII were used, the most profitable period of fattening, at least when labor values are not considered, is the two week period. The three week period gave slightly better sults than the ten day period, but here ag labor has not been considered.

When the results shown in Table II compared with the results shown in Ta III, it will be seen that for the three a two week periods respectively the mediu sized chickens gave better results than t large-sized ones, but that for the ten d period the large-sized chickens gave bett results than the medium-sized chickens.

The results of a comparison of differe rations with large-sized chickens for t three fattening periods is shown in Tab IV. Rations I and III are identical exce that Ration I was moistened with water a

Table III Showing the Comparative Results of the Three Fattening Periods with Medium-sized Chickens with Rations III, IV, VI and VII.

Period	Ave. Wt. lbs.	No. Birds	No. Lots	Basis of Comparison	Unfattened	Fattened	Percentage Gain	Ration Consumed	Milk Consumed	Percentage Gross Revenue on Cost
Three Weeks	3.14	148	23	Wt. in lbs.	465.75	640.55	37.53	698.25	887.75	143.74
				Value in $	83.82	147.32	75.76	14.32	4.35	
Two Weeks	2.95	241	37	Wt. in lbs.	711.25	957.25	34.59	788.50	1327.86	146.91
				Value in $	128.01	220.16	41.86	16.01	5.84	
Ten Days	2.76	102	17	Wt. in lbs.	281.56	352.00	25.03	234.75	449.88	140.58
				Value in $	50.68	80.95	59.73	4.93	1.97	

Table IV Showing the Comparative Results of Different Rations with Large-sized Chickens

Ration	No. Birds	Ave. Wt. lbs.	Basis of Comparison	Unfattened	Fattened	Percentage Gain	Ration Consumed	Milk Consumed	Percentage Gross Revenue on Cost
I	80	4.71	Wt. in lbs.	377.00	437.25	15.98	448.75	-	132.19
			Value in $	67.86	100.57	48.20	8.22	-	
III	72	5.44	Wt. in lbs.	392.25	500.25	27.53	414.00	623.94	140.48
			Value in $	70.59	115.06	62.99	8.57	2.74	
VI	102	5.08	Wt. in lbs.	518.25	665.06	28.33	564.00	780.23	141.43
			Value in $	93.27	152.96	63.99	11.46	3.42	
VII	102	5.49	Wt. in lbs.	560.00	708.81	26.57	534.75	747.98	139.56
			Value in $	100.79	163.02	61.74	12.73	3.29	
VIII	72	4.01	Wt. in lbs.	289.25	377.75	30.60	319.00	-	148.69
			Value in $	52.06	86.88	66.92	6.38	-	

Table V. Showing the Comparative Results of Different Rations with Medium-sized Chickens

Ration	No. Birds	Ave. Wt. lbs.	Basis of Comparison	Unfattened	Fattened	Percentage Gain	Ration Consumed	Milk Consumed	Percentage Gross Revenue on Cost
I	50	3.22	Wt. in lbs.	180.50	213.25	27.17	234.50	-	133.33
			Value in $	32.48	49.04	50.99	4.30	-	
II	40	2.71	Wt. in lbs.	108.50	145.50	34.10	156.00	-	145.98
			Value in $	19.52	33.46	71.41	3.40	-	
III	170	2.81	Wt. in lbs.	478.82	643.75	34.44	612.25	934.83	145.88
			Value in $	86.18	148.06	71.80	11.20	4.11	
IV	162	3.11	Wt. in lbs.	503.75	694.30	37.83	602.75	961.81	147.82
			Value in $	90.67	159.69	76.12	13.14	4.22	
V	32	2.91	Wt. in lbs.	93.00	130.75	40.59	128.00	225.50	143.53
			Value in $	16.74	30.07	79.63	3.22	.99	
VI	93	2.94	Wt. in lbs.	274.00	354.75	29.47	305.00	507.25	141.43
			Value in $	49.31	81.58	65.44	6.13	2.24	
VII	66	3.06	Wt. in lbs.	202.00	257.00	27.23	201.50	361.50	138.31
			Value in $	36.35	59.10	62.59	4.79	1.59	

Ration III was moistened with sour skimmilk. Rations VI and VII differ chiefly in respect to the amount of beefscraps in each, Ration VI having ten percent and Ration VII twenty percent. Ration VIII contained five percent beef scraps and five percent milkstock and it also differed from Rations VI and VII in being moistened with water instead of with sour skimmilk. The results of the comparison show that Ration VIII gave the best results. Concerning the results from Rations III, VI and VII there is but little difference. The use of twenty percent beef scraps does not give quite as good results as ten per cent. beef scraps, and the use of milk alone gave practically as good results as the use of milk and ten percent beef scraps. It is possible that a ration containing two or three percent beef scraps in addition to milk might give as good results as a ration containing ten percent beef scraps and milk. The results secured with Ration I show that the use of milk or beefscrap is necessary to get the most profitable returns.

The results of a comparison of different rations with medium-sized chickens for the three fattening periods is shown in Table V Rations I and III are similar except that Ration I is moistened with water while Ration III is moistened with sour skimmilk. Rations II and IV are similar except that Ration II is moistened with water and Ration IV is moistened with sour skimmilk. Rations I and II are similar except that Ration I has no beef scraps and Ration II has ten percent beef scraps. Rations III and IV are similar except that Ration III is moistened with milk while Ration IV has ten percent beef scraps as well as being moistened with milk. Ration V is similar to Ration IV except that it contains twenty instead of ten percent beef scrap. Rations VI, VII and VIII have been mentioned in connection with the previous table.

The best results were secured with Ration IV, which contained equal parts by weight of oatmeal, cornmeal and buckwheat and ten percent beef scraps, the whole being moistened with sour skimmilk. Ration II, exactly the same as Ration IV except that it was moistened with water instead of sour skimmilk gave the next best results. Practically as good results were obtained, however, with Ration III, which contained equal parts by weight of oatmeal, cornme and buckwheat, the whole being moisten with sour skimmilk. The poorest results all were secured with Ration I, and it is a parent that skimmilk or beef scraps shou be used to get the best results. When t results secured with Rations IV and V a considered it is apparent that the use twenty percent beef scraps is not justifie This is borne out again when the results s cured with Rations VI and VII are conside ed, and it is significant that Rations VI an VII gave very similar results with larg sized and medium-sized chickens. Conside ing the results shown in Table V as a whol it is apparent that the use of ten perce beef scraps in a ration moistened with sou skimmilk is justified although it is qui possible that a small percentage of be scraps might prove to be more economica than ten percent.

Conclusions

The size of chicken determines the mos efficient length of fattening period.

Large-sized chickens, in bred-to-lay strain of Barred Plymouth Rocks and Rhode Islan Reds, require a fattening period of abou ten days, while medium-sized chickens re quire a fattening period of about two weeks

Where a mixture of two or more stapl grains is used as a basal part of the ration the use of sour skimmilk to moisten the ra tion is necessary to produce the best results

Where sour skimmilk is not available, th use of about ten percent beef scraps is nec essary to produce the most profitable gains

Where sour skimmilk is available, the us of ten percent beef scrap seems justified although it is possible that a smaller per centage might prove to be more economical

Where sour skimmilk is available, the use of twenty percent beef scrap does no seem justified.

Under the conditions of this experiment the best results were secured in the following cases: large-sized chickens fattened on Ra tion VIII for a period of ten days gave a gross revenue percentage of 150.91 on the cost of the unfattened chickens and the feed and milk consumed; medium-sized chicken fattened on Ration IV for a period of two weeks gave a gross revenue percentage of 149.24 on the cost of the unfattened chickens and the feed and milk consumed.

The Rise of Our Marketing Problem and How We are Meeting It.

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I. The Marketing Problem Brought About by Agricultural and Industrial Expansion.

The study of our systems of marketing is one of recent years. It is only within the past decade that educational institutions have thought fit to include the subject on their curricula. During the past five years the introduction of marketing education has taken fairly general hold on the American Agricultural Colleges. In many of the Colleges complete courses leading to a degree can be obtained. While the majority of our Canadian Colleges and Universities provide some instruction on Agricultural Economics as a part of the general course in economics, few of the Colleges have got to the stage where the study of marketing in itself commands a special course or where a student can take his degree and specialize in marketing. The fault does not lie with our institutions but rather with the lack of funds and from the absence of an insistent demand on the part of the people that such instruction be given.

Until a few years ago it was considered that the farmers' job was to *produce* and to leave the marketing of his produce to others. It was even implied at times that the marketing of farm products was a deep and mysterious undertaking which required ability possessed only by a favored few. The farmer was to produce for 364 days in the year and on the three hundred and sixty-fifth turn it over to one of those who understood the mysterious process of marketing.

Today the system is changed. Farmers as well as the public in general are studying the markets and there has grown of recent years a considerable fund of information. So insistent has been the demand in the States that colleges now offer complete courses in marketing, Departments of Agriculture provide marketing bureaus and market laws and public money is being voted for the use of specialists whose duty it is to study and publish the fullest information concerning the marketing of our various farm crops.

But why has all this interest been created in marketing? It is true that the depression in agricultural sections has created a demand for greater knowledge and more study of the means of remedying the unfortunate position in which farmers today find themselves. As one of these means it is natural they should turn to marketing, since the attention given to production has in reality made "two blades of grass grow where only one grew before". Someone, some day, may discover what it was intended should be done with the second blade! It is true today that marketing is becoming "the other half of agriculture" but to discover why we have a marketing problem it is necessary to go farther back in history.

The Industrial Revolution.

The real reason for our marketing problem of today can be traced to certain inventions which first saw light in the closing half of the eighteenth century. Until the middle of the eighteenth century there was nothing of the industrial development that we know today. True, there were towns and a few cities of size in the British Isles and also on the continent, but for the most part the inhabitants of such lived upon the products of the soil of a small territory within or nearby the city. There was no movement of foodstuffs that might be called marketing. In some parts of the country a crop failure would be experienced, but it was impossible to bring food stuffs from a distance. The unfortunate ones would go short or starve until the next crop was ready. It must be remembered that there were no railroads, no steamships, telegraph, telephones, cables, electricity, steam or other power machinery.

If you think of the relationship of power machinery to any of our modern processes of manufacturing you will appreciate how little could be done and how crude the methods of making things were at that time.

Then a great change took place. In 1764 Hargreaves invented the Spinning-Jenny. In 1768 Arkwright brought out his spinning-machine and then Crampton in 1776 invented the "mule" which was followed by discovery of the power loom. These inventions however, would have been practically useless had not Watt in 1765 built his steam engine. In 1778 a mill was set up at New Lanark. This was the beginning. Of this period Maxwell says, quoting Graham, "Starving droves of Highlanders came south from impoverished crofts, and not too heartily worked in the factories; ploughmen left the fields for the mills, and farmers were forced to raise their wages to keep workers in their service. Hundreds of poor children were brought from Edinburgh to the mills at Lanark, where good David Dale took care of the training of their souls, but kept their bodies at toil from six in the morning till six at night, with only one hour's interval for rest and food. It is recorded that by 1796 180,000 men, women and children were employed in cotton factories in England and Scotland, while thousands of others more or less directly gained a livelihood from it. This rush to the towns changed the conditions of life entirely: Many men who had been reared in poverty now started in business in a small way, and in a few years amassed a competency; others were satisfied with a small regular income, and remained docile workmen to the end of their days."

About this time also coal mining became an industry. Previously the mines provided fuel for those who lived in the vicinity. In 1760 the Carran Company established an iron works at Falkirk. Here was a new use for coal. By converting coal into coke Dr. Roebuck made the smelting of iron possible without charcoal. Then Smeaton introduced the blowing engine. "This, applied to Roebuck's idea, created a large demand for coal; iron-smelting and coal mining developed rapidly. Iron foundries arose; employment became plentiful. The Highlands and Ireland furnished many recruits for the Industrial Army."

The history of the industrial developme is in itself intensely interesting. The inve tions and discoveries described above we only the beginning but they paved the w and made possible the huge manufacturi plants of today, the railroads, steamshi telephones, telegraph, cable, gas engine aeroplanes and the hundred and one mode devices, inventions, etc., which we accept as matter of fact, little thinking that there w a time when these things did not exist. T manufacture of these things meant factori and workmen and soon towns and final cities grew up around the factories. Thus w see the depopulating of the rural sections the older countries and the concentratio of people in large centres.

The Self-Sufficing Period of America Agriculture.

Let us now turn our attention to the ne continent. What was happening in America At the beginning of the nineteenth centur about three million people were numbere in America. They lived upon the product of the soil and the hunt. Every man had small farm and busied himself enlarging hi "clearing". Settlement was largely alon the Atlantic coast, thinning out toward th great lakes and the Mississippi. In this reg ion almost everything could be grown. Build ings and furniture were made from trees o the farm. Small quantities of grain were grown to be ground into meal and flour fo the family. All vegetables were grown, ever to the spices, mint and caraway, sage and pepper. Berries and tree fruits were easily cultivated. Sugar from maple sap was ob tainable and, together with honey, provided the sweets. A cow or two with a few pigs provided the milk and meat. Sheep con tributed wool which was spun on the spin ning wheel, a common sight in every home Skins and furs of animals, both wild and domesticated, were widely used as clothing Nearly everything required by the family was grown or manufactured on the farm. Implements were few and crude. The plow was little more than a sharpened stick. The sickle and flail and later the scythe completed the harvesting. Under these conditions only a few acres of crop could be grown. The teacher, the preacher and the doctor were supplied by the community with the necessaries of life in exchange for their services.

This is the stage in American history known as the self-sufficing period and it covered the time from the Pilgrim Fathers to the beginning of the nineteenth century and in some districts survived even later. In Canada the period referred to lasted longer. The older generation of today easily remembers when the conditions described above existed in Ontario, Quebec and the Maritime Provinces. As late as the eighties of the last century the eastern farmer was pretty much self contained.

Rise of Industrial Centres and Rural Depopulation.

Thus we have seen what happened prior to our time, in what are frequently called the "grand old days". In the vernacular of the present "those days are gone forever." The inventions of the old land were being introduced to the new continent and as they came one by one they each added a note to the knell that tolled the departing of the self sufficing period in American Agriculture.

The growth of industrial centres and the depopulation of rural districts in the United States may be seen in the following figures taken from the census.

Persons engaged in American Agriculture as an occupation as compared with the total number of persons engaged in all other American occupations. (Hobson, Columbia)

1820	87.1
1840	77.5
1870	47.5
1880	44.4
1890	39.2
1900	35.7
1910	32.9
1920	30.

The ever increasing shift from rural to urban pursuits is clearly seen from the above. Instead of every man being self sufficing on his own farm, there are today less than one-third of the population producing the nations food stuffs; in other words every man produces enough for two others.

Similar figures secured for Canada show the tendency north of the boundary. They also indicate that the shift city-ward was slower.

1891	Rural population	72.3 %
1901	" "	62.4 %
1911	" "	54.4 %
1921 (Incomplete)	"	56.81%

(P.E.I. and Yukon returns not available.)

Incidently the above figures answer the question, "Why do so many of our great men originate on the farm"? Assuming that the majority of our leading Canadian citizens are at least forty years of age it will be seen that the odds are three to one they were born on the farm.

The Marketing Problem.

What effect had all this on agriculture and particularly on marketing? The answer is perfectly clear.

The scenes enacted in the British Isles back in 1770 or thereabouts were repeated a few years later on the new continent. The inventions referred to were introduced to America and resulted in huge cities. New York, Chicago, Philadelphia, Pittsburg, Montreal, Toronto and hundreds of other smaller cities were built up as a result of the factories and mines made possible by the inventions referred to above and those for which they paved the way.

As these industrial centres developed, it became necessary to feed them. They soon outgrew the productive capacities of the surrounding territory. New fields of production were sought and immigration pushed westward and northward. The Mississippi and the Great Lakes were soon passed. The great middle west and Pacific Coast were under the plow and finally the north-western States and Western Canada. The new lands were different from the old eastern homesteads, the climate was different, forty acres would no longer do. The settler must have more acreage of the new land. The old hand methods of cultivation were inadequate and so the inventive genius was applied to agriculture and first one and then another invention brought out new types of farm machinery which made possible the cultivation of these large farms. But these new territories would not support the farmer independently as the old "forty acres" back east did. It was soon found that one section would not grow apples or peaches, or maple trees or corn. So each district became a district of special crops; the wheat farmer produced wheat far and above his needs because he must buy the other necessities of life. So of the man in the south who found his land best suited to cotton or the new settler on the coast who found the growing of almonds or grape fruit best suited to his conditions.

Thus arose our marketing problem, the problem of selling the surplus to buy the other necessities of life. The growth of large cities in the east brought it about and while these same cities became absolutely dependent on the new fields of production it was equally true that these new settlers we just as dependent o nthe eastern cities for market and for the manufacture of the nece sities of life which could not be produc on these new farms.

II. Why We Have a Middleman System.

Functions Performed by Middlemen.

In the foregoing material the writer has attempted to show how and why our present system of marketing has been developed. We now turn our attention to the agencies that handle the marketing of our products and in so doing bring the producer and consumer together.

The public have long been accustomed to view the middleman with suspicion and to consider him as an unnecessary evil situated somewhere between the producer and the consumer and whose only purpose was to extract toll from the products that must go through his hands. It is not surprising that the public should have this view. The press have for long put this view before their readers, this failing being particularly evident in certain of our agricultural journals which seem to like nothing better than to publish cartoons depicting the bewhiskered and insignificant farmer at one end and the robust and prosperous moneyed magnate at the other end of the chain extending from producer to consumer, while in between is a sort of devil into whose pockets a steady stream of money represented as "leakage" is passing. Very few attempts have been made to show why we have a middleman system and why such a system is absolutely necessary. The failure to appreciate this fundamental fact has resulted in the failure of scores of farmers' co-operative enterprises. It is not the writer's intention to defend an elaborate and expensive system of middleman. Producers in the past have suffered at the hands of agencies entrusted with the marketing of their produce, but the idea must be dispelled that we can get along without a middleman system. With few exceptions the producers and consumers can perform their own marketing activities by means of co-operation but until that is done, private enterprise must continue to fill the breach.

A Middleman System is Essential.

There are four principal reasons why middleman service is necessary. Each them may again be subdivided:

(1) Distance of our large consumin centres from the sources of production.

(2) Seasonal production but continuou consumption.

(3) The demand of the consumer for standardized product.

(4) The necessity of manufacturing pr cesses between the producer and consumer.

We will consider each of these separately

(1) Distance of Producer from Consume

In order to emphasize the distance th producer is separated from the consumer le us consider the various items together wit their sources of origin, that enter the tverag family bill of fare in the city of Regina during the course of a day. Incidentally it furnishes an interesting study in geography. For breakfast the grapefruit comes from either Florida or California, the oat meal, cornflakes, shredded wheat, or other cereal probably originated here in the west but the product as we get it most likely comes from east or south. The puffed rice comes from China. Eggs or bacon are home grown but if it is February or March the eggs may have come from Kansas. Toast is a home product. Our coffee comes from Brazil or Java or other points in the south or east. If it is tea, the Hindu, the Jap or the Chinese likely grew and processed it. Postum originates as such in Michigan.

To provide the mid-day and evening meal we find that even more remote places are drawn upon. Some of the vegetables and meats will be home grown. Olives come from the southwest coast, certain parts of the eastern states and from many European and Asiatic points. Spices originated in

the Orient. Sweet potatoes probably come from Georgia or Louisiana. Fish comes from either the east or west coast or the Great Lakes; sugar from the southern States; dates, figs, etc., from a southern clime. The Christmas cranberries come from New York or bordering States; apples from Washington, British Columbia or Ontario and so on. Practically the whole world is drawn upon to furnish something for our larder during the course of a day. To make the picture even more clear consider the resident of London, England, who is supplied with beef from the Argentine or Canada, wool and mutton from the sheep of Australia, bacon from Denmark or Ireland or Canada, cheese from Canada as also butter and eggs, fruit from the United States or Canada, tea, coffee, spices, rice and other such commodities from India, China, Japan or other eastern countries. Truly as someone has said "the average modest salad has an international aspect."

As long as population was practically confined to the eastern coast of America and each family had a small farm whereon could be grown most of the requirements of the home there was no such movement of the world's food supply, but by way of contrast consider the position of cities like London, New York or Paris or even our own Montreal or Toronto. If the marketing machinery or middleman system were to suddenly fail the city of New York, suffering would be experienced in 24 hours and within a week the entire population would either be dead or have to move to places where food could be obtained.

Direct Marketing Has Limited Field.

It requires no very great wisdom to see that there must be someone to bring that product from producer to consumer. Direct marketing will not do it. The producer of poultry products in Petaluma cannot be in touch with private patrons in New York. The Argentine rancher finds it impossible to sell his beef direct to the London consumer. Parcel post marketing of farm produce has a very limited local field. There are several reasons why it will never be a huge success; briefly they are as follows:

(a) Many farm products too perishable; i.e., eggs, berries.
(b) Must have high instrinsic value to stand expense, farm produce not in this class.
(c) Consumer demands a continuous supply; farmers' production is seasonal.
(d) Requires too much time to hunt patrons.
(e) Consumer desires to inspect farm produce personally.
(f) Farmer not trained in art of pleasing the buyer.

Perhaps the foregoing will suffice to show why national direct marketing will never be feasible though it may always be possible to apply it to marketing by farmers near cities or towns.

Functions Performed by Middlemen.

Let us consider what agencies we need to bring the producer and consumer together. To illustrate, suppose we consider poultry raised in Saskatchewan, many carloads of which reach Toronto, Montreal, Chicago, New York and Liverpool. Starting at the farm we find the good wife has a hundred chickens to sell and no local market. She cannot reach the consumer in one of these distant cities so she sends it to Regina, Saskatoon or Moose Jaw where it is received along with hundreds of other shipments. Here it is assembled into car loads by a receiving company. It is economical also to do this because it goes forward now at carload rates which are only a small percentage of the L.C.L. rates. Here then is the first middleman. But this first receiver cannot be expected to reach the thousands of consumers or the hundreds of retail stores, neither does he know the requirements of the scores of wholesale receivers in these scattered cities and to wire them all would entail heavy expense. So he wires one man in Winnipeg known as a broker telling him what he has to offer.

Now let us jump to the other end and consider a consumer in one of the foregoing cities. A chicken will suffice for a family dinner in Montreal. Could the housewife purchase that chicken from any one of the parties mentioned? No, it is economically impossible. She buys from the corner grocer or butcher who is there to serve her. She

demands service of the most expensive kind. She wants one chicken or a slice of beefsteak, a peck of potatoes or 3 lbs. of apples and she wants to pick out the best. There are several thousand of these retailers in Montreal alone. Can they each get in touch with the Winnipeg broker? No, it is not practicable and besides they have no storage and they want only two or three dozen chickens at a time. So they use the telephone and call some one man whose business it is to assemble carloads of stuff in Montreal and break them up into small orders for these retailers. This man is called a "jobber". Now this jobber finds it comparatively easy to get the chickens required because all he has to do is wire this "broker" whom we have already met in Winnipeg and so the transaction is complete and the service of marketing performed, but note that there were four middlemen between the producer and consumer and they were *absolutely essential.* In the marketing of some products the channel is more direct, in others still more service is required.

With most products these services can be performed by the co-operative organisation of producers and consumers. So far it has not been found feasible for the producer co-operative to do the retailing in the distant city; they have however, reached the stage where they can economically put their product in the retailers hands—but *they have not eliminated* the middleman because they perform the same services themselves. Take the case of Okanagan apples. The B.C. farmers have now a pretty complete selling organization but all the middleman services are there. All the farmers around a certain point send their apples to their own receiving station in the local town. Here they are graded, packed and assembled into car loads. The head office (the broker) is then advised and arranges for sale. The Company has a subsidiary organisation known as the Growers' Sales Agency which has branches in all the leading Canadian cities and several American points. These locals are constantly in touch with the head office at Vernon. They, then, are the jobbers located in the consuming centres who in turn supply the retail stores. No service is eliminated although some of the profit of the middleman service is saved by the grower. It is possible to have too many middlemen and very often that is the case.

(2) Seasonal Production

Let us look at this for a moment. We are no longer content as consumers to eat lettuce or strawberries, or celery only when such can be grown locally. We demand fresh lettuce all through the winter and other seasonal crops too, so that those who satisfy our wants must go farther afield in search of food stuffs. While the lettuce we in Regina eat in May or June is probably grown locally it is impossible to store the product for next March, so our middleman must bring lettuce from some place where *it is* grown in March. He probably goes to Florida for it. But here again we have a real middleman service.

Or turn to still another angle. We cannot buy fresh eggs in January but it is possible to hold eggs from the previous June in cold storage to satisfy our discriminating wants. Here then is still another middleman service which must be performed.

(3) Consumer Demands Standardized Product.

We are in an age of standardization. The housewife buys grapenuts in packages, every one alike and the contents of which are absolutely uniform. Every bar of palm olive soap, every bag of rolled oats, every tin of baking powder, every pail of fruit, and every jar of pickles is exactly like all others of the same brand or make and the contents of each are uniform. Not only that but every one is guaranteed. The housewife no longer looks at her purchase, she simply orders "Quaker Oats," or "Heinz Pickles" or "Magic Baking Powder" and knows exactly what each will be like.

Manufacturers have got the art of uniformity and standardization down to a very fine point and now the consumer is demanding the same thing of farm products, but this demand cannot be met so easily. There will always be small potatoes and "runty" pigs but to the farmer the potatoes are all good eating and the small pig eventually makes bacon good enough for him. He cannot appreciate this "fickleness" of the buying public and he has been slow to grade and select his product. The service must be

performed however and so it has fallen to the lot of those we call middlemen. The local co-operative packing plant did it for the Okanagan apples but in the case of Saskatchewan potatoes the first buyer usually has to do it. Again then we have a middleman service.

(4) Processing Agricultural Products

We now come to the fourth important reason why we have a middleman system, namely, the necessity of changing the state of certain agricultural products before they can be used by the consumer. This you may call manufacturing though the term "processing" fits certain cases perhaps equally as well.

To use a familiar example of manufacturing attention might be called to the Saskatchewan Co-operative Creameries. This company and all other companies like it take cream and convert it into butter or ice cream. The state of the cream is completely changed and in the first case an entirely different product results. The same thing has taken place in breakfast foods one buys in packages. The foundation of most of them is wheat, corn or rice, though the finished product may little resemble the original. Oatmeal is a familiar example of processing oats. Tobacco as we buy it from the shop bears little resemblance to the broad leaf that grew in Quebec or Virginia. So widespread has become the custom of processing that there is today hardly a farm product that is not entirely or partially processed. Grain, milk, meat, fruits, vegetables, poultry products, wool, forage crops, tobacco, all or part are processed. Consider then whether we could do without this form of middleman service?

Conclusion.

Little need be said in conclusion. The reader, if he considers the questions which have been merely introduced, if he will follow them into every phase of agricultural production, will appreciate that there is much more to this question of marketing our farm surplus than appears at first glance, and he should be more than ever convinced that in our present state of civilisation there is no such thing as "independence" either when applied to the individual or to a section of the community. There are services to be performed which neither the producer nor the consumer can undertake. A greater appreciation of the services performed by the other fellow will make for better mutual understanding.

III. Will Farmer Co-operation Solve Our Marketing Problems?

In the two previous sections we considered the history of our present marketing problem and the services performed by those entrusted with that marketing. It may now be in order to ask if this service cannot be performed by the farmer through his own agencies.

In this connection it should be noted that some one at one time or another has to undertake the disposing of our products. The farmer in the earlier days did not do it himself, therefore it was done by some other person. These parties did not do it with any altruistic motive. Their only object was one of straight monetary gain and they considered the producer only to the extent that it best served their own interests. This is a trait of human nature which, while perhaps not laudable, nevertheless exists; it is not peculiar to middlemen alone. The toll they have taken therefore has in the past been heavy and it is not unnatural that the same motive, that of personal gain, should impel the farmer to undertake the marketing of his own product with the belief that he can save, and is entitled to save, much of this profit which in the past has gone to others.

A little thought on what has already been done by the farmer in co-operative marketing will convince the most skeptical that the man on the land, when forced to it, can do much more than his critics in the past have believed him capable of.

There is hardly a field of agricultural marketing today which has not experienced

co-operative organisation in some form or another. Even places where one would least expect co-operative development, the farmers have been forced in recent years to adopt the principle of organized marketing in order to make both ends meet.

There is no more striking example of this than the co-operative sales organsations built up in the southern states where for many years the people looked upon organized marketing as an outgrowth of northern agriculture and a development which could not be applied to the efforts of southern farmers. In contrast to this attitude we now find a giant cotton organisation covering most of the territory where cotton is grown, an organisation of the contract variety where the individual farmer pledges himself to deliver to his co-operative sales organisation the whole of his output over and above seed, for a certain period of years.

Closely bordering on the territory where the cotton organisation operates and in some places even overlapping you find another organisation of a similar nature to handle the tobacco crop. This is perhaps the most recent organisation of its kind brought into being.

Going a little north from the tobacco organisation, in the eastern states we find an organisation under way to handle maple sugar and maple syrup, a production of the New England States, while still further north there are signs of a similar organisation among the farmers of Ontario.

Co-operative organisation among the wheat farmers is much better known to the general public and needs little consideration here. The machinery set up in Western Canada a number of years ago for the handling of wheat and other grain on a co-operative basis is still an outstanding example of co-operative grain marketing. The efforts of the farmers of the central and western states along these lines however should not be overlooked for there is hardly a state where wheat is grown, that has not a sufficient number of co-operative elevators to guarantee to the farmers a price approaching what the grain is actually worth on central markets.

It is fortunate that the giant organisation known as the "United States Grain Growers Incorporated" has not made more sa factory progress. We may expect howev that with the recent reorganisation and introduction to the directorate of sound bu ness men, combined with the ability brou to bear by real farmers, may have a ben cial effect which will put that organisati on its feet.

In the realm of fruit marketing we ha the example set by the Pacific Coast bo north and south of the International bou ary. The organisations across the line a of two types although they are commor confused under the general name of t California Plan.

There are two distinct developments ho ever in this field, the one fathered by t late Mr. G. P. Powell, and the other Mr. Aaron Sapiro. Their respective orga isations differ fundamentally. Mr. Pow believed in the principle of local gover ment, his idea being to buid up a successi of local units which in turn should organi a central selling agency, and over whi these locals exercise a complete authority

Mr. Sapiro on the other hand, believes the central organisation with control ov a number of district locals, the central offi having practically complete autonomy. Bo organisations have been working satisfacto ily for many years. So successful are th that in their respective fields they hand from 50 to 100% of the products of t farms.

In British Columbia we have a very su cessful enterprise conducted in the Okanaga Valley and built up upon the princip enunciated by Mr. Powell. This organis tion of British Columbia growers has dem onstrated beyond all question of doubt th value of co-operative organisation in marke ing. So successful have they been that the have been able to place British Columbi fruit, apples in particular, in the cities o Ontario in the heart of the apple distric and have these apples sell at a premium while the product of the Ontario farm ha often hung on the trees for want of a mar ket. The British Columbia growers hav also been able to place their apples by hun dreds of cars, to great advantage, on th New York market.

At this stage it might not be out of place to point out that the reason the British Columbia and California Growers have been able to put their product right into the enemies' camps is because of organisation and standardization. These two things run hand in hand and it is a peculiar fact that the latter always follows the former when co-operative principles are applied. The Pacific Coast boxed apples, or crated oranges, lemons, etc., are recognized by all of our markets and we regret to have to say that in many cases they present a considerable contrast to the methods adopted by growers of similar products in other sections.

There was a time in Western Canada when Ontario barrelled apples were the only apples which could be bought. Today it is a very rare thing to see a barrel of Ontario apples in a Western store. Organisation with its resulting salesmanship and its standardization has crowded the eastern product from the market.

In the field of live stock the co-operative principle has also been applied. All of the live stock producing states as well as most of the Canadian Provinces have organised for the co-operative shipping of stock and in many of the states and provinces the farmers have invaded the livestock exchanges and public stockyards where today farmers co-operative commission companies exist. Co-operative marketing of live stock is firmly entrenched and although one of the recent forms of co-operative endeavour, bids fair to supplant the old system of marketing as carried on by the buyer and drover.

In the realm of dairy production co-operation has made rapid progress. Wherever the cow exists at the present time you will find some form of co-operation. A few of the outstanding developments of this sort are found in the Dairymen's League of New York and Pennsylvania, the co-operative selling of dairy products by more than 400 co-operative organisations in Minnesota, and the organisation in Saskatchewan known as the Saskatchewan Co-operative Creameries.

Nor have we by any means exhausted the field of co-operative endeavour when we have mentioned the above. The potato growers of all parts where potatoes are an important crop have organized for co-operation. Organizations of this kind are found in the Maritime provinces, in Maine, Michigan, Minnesota, the Dakotas, Alberta and in other places less prominently before the public eye.

As a result of the increased interest taken in poultry production we find many examples of co-operative poultry production and marketing. Particularly outstanding are the California, Washington, and British Columbia producers' organisations. So successful have they been of recent years in marketing their productions clear across the continent that they have forced the eastern poultry producers to adopt similar methods, with the result that in New Hampshire and New Jersey producers have effected similar organisations and the farmers of Ontario and Quebec, as well as the maritime provinces, have begun similar action.

Can the farmers themselves perform the middleman services? The answer is "certainly they can", and they have demonstrated over and over again that when they undertake such services they market a better product. Why? For the simply reason that they learn for the first time exactly what the consumers want. Private traders have no desire to educate the producer in most cases, nor can they afford to, even had they the desire. They make their money buying mixed lots of potatoes or apples cheaply. Then they sort and grade them, raising their value upon which they make their profit. It is not surprising then that little progress was made in the improvement of farm produce until the giant producers' marketing organisations came into being. Twenty years ago there was hardly a co-operative marketing agency. Today there is hardly a field that is not touched. The majority of those organisations mentioned earlier perform complete middleman services and do them better than the old agencies were capable of doing.

In conclusion it may be said that there is hardly a community, state or province where there is not some form of co-operative production and marketing. The progress made by farmers in self organisation during the past decade must convince the most skeptical that the old adage "farmers cannot pull together" is lacking in foundation.

Experiments in the Control of the Apple Sucke (*Psyllia mali Schmidberger*) in the Adult Stage.

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Since the control of the apple sucker by spraying for the nymphs is so dependent upon the skill and thoroughness of the operator and since control by either spraying or dusting is a costly proceeding, it was decided to attempt open air tobacco fumigation, the use of which has been favorably reported upon from Russia. For this purpose we had on hand a supply of tobacco stems and spoiled leaf tobacco, as well as a quantity of dust, which we afterwards found to contain a large proportion of non-combustible material.

Three small blocks of orchard, designated A, B and C, were chosen for the tests, the details of which follow.

Block A. This block consisted of closely planted trees, twenty-five to thirty years old, and being situated in a hollow, sheltered on all sides from the wind, presented ideal conditions for the successful application of this method. Furthermore, it was in the very centre of the infestation, the insects being so numerous that, at the slightest disturbance of the limb, the patter of their bodies was like a shower of rain upon the foliage.

Details of Experiment. On August 2nd after a night of rain, the air being saturated with moisture, conditions were considered ideal for the carrying out of the experiment. Small heaps of dry hay were laid throughout the orchard and waste tobacco leaves or stems placed thereon, one heap midway between four trees.

After lighting a few fires it appeared that the material was going to be consumed too rapidly owing to its dryness. Before lighting any more fires, therefore, a small quantity of wet weeds was mowed and placed on each heap. This had the effect of slowing down the fires and preventing them from bursting into flame and the steam given off by the wet weeds seemed to have the effect of producing a denser, heavier smoke. After all the fires had been ignited a slight breeze sprang up, but as it seemed to constan change its direction, its effect was to ca the smoke to circulate round and round t orchard.

The fires were started at 11 A.M. a some of them smouldered until late in t afternoon, but the period of maximum fu gation could not have been more than 1 to 2 hours. The smoke produced was ve dense, hanging low over the orchard a did not rise and become dispersed as rap ly or to the extent that had been expecte

Results. On going through the orcha at 4 P.M. the experiment seemed to ha been a great success, for scarcely a livi apple sucker was in evidence. Those maining on the foliage of the lower lim were for the most part apparently dea hanging with their tarsi, entangled in t pubescence of the leaf. The surface of t ground and the leaves of weeds benea the trees were also littered with their bodi It was estimated that the mortality on t lower limbs was at least 99%. In the to of the trees a somewhat larger number we still alive, but most of these were inactiv

On a sheet with an area of eighteen squa feet, the bodies of 1320 apple suckers we counted. Upon examination the next d 150 showed signs of life. These were plac on apple seedings and three days late twenty, or 1.52% of the total, were fou to have apparently regained normal activit

SUMMARY OF TREATMENT

Area of orchard, 1 acre.
Number of trees, 50.
Number of fires, 36.
Date of Application, Aug. 2nd, 1920.

Materials:

210 lbs. tobacco stems and leaves.
150 lbs. dry hay.
70 lbs. weeds.

Labor:

Laying out material, etc., 1 horse and wagon and 3 men,	1 hour
Mowing weeds,	45 minutes
Lighting fires, 3 men,	30 "
Attending fires, 1 man,	2 hours.

Cost per 50 *trees*: $8.25.

DETAILED COST OF TREATMENT

210 lbs. Tobacco waste @ 2c lb.....	4.20
150 lbs. Hay @ $30 per ton	2.25
1 horse, 1 hour, @ 25c per hour	.25
Labor, total 7 hrs. 15 min. @ 25c hr...	1.82
	$8.52

Block B. This is a small garden orchard of a mixed nature, consisting of trees from 20 to 40 years old. It is fairly isolated, being shut in by a high hedge, but in a heavily orcharded locality.

Details of Experiment. Tobacco dust was used in the test and, since the material contained much sand and other incombustible material, our chief difficulty was in getting it to burn satisfactorily. Heaps of hay were scattered through the orchard and the dust carefully sifted through the hay.

On August 13, the date of application, conditions were very similar to those of the previous treatment, viz., rain the previous night, with a heavy saturated atmosphere. A breeze that came on half way through the experiment was, however, somewhat more steady in its general direction, so that several heaps of material which had been kept in reserve for this eventuality were moved to the windward side of the orchard and ignited, the smoke drifting the entire length of the field before being lost.

Results. The results of this fumigation appeared to be equal to those on Block A on the lower limbs, but a larger percentage in the tree tops remained unaffected, though more material was used. This may be due to the fact that the tobacco dust used was far more pure, 65% consisting of incombustible material.

SUMMARY OF TREATMENT

Area of orchard, ½ acre,
Number of trees, 34.
Number of fires, 20.
Time of fumigation, 2 hrs.
Date of application, Aug. 23, 1920.

Materials:

180 lbs. tobacco dust.
170 lbs. hay.

Labor:

1 horse and wagon,	1 hour.
3 men,	¾ hour.
Lighting fires, 2 men	½ hour.

Cost per 50 *trees*: $13.27

DETAILED COST OF TREATMENT

180 lbs. tobacco dust @ 3c per lb.....	$5.40
170 lbs. hay @ $30 per ton.....	2.55
1 horse, 1 hour @ 25c per hour	.25
Labor, 3¼ hrs. @ 25c per hour	.82
	$9.02

Block C. The area involved in this test was one and one-half acres, but only forty-one trees are included in this area. These are old trees 40 to 50 years old and some of them very high.

Details of Experiment. A combination of tobacco stems, leaves and dust was used in this experiment. Just prior to lighting the fires several very heavy showers almost saturated the heaps in the open, and considerably dampened those beneath the trees, the tobacco dust on the top of each heap being reduced to a wet, musty mass.

A few drops of kerosene were accordingly placed at the base of each heap which was then lighted by a torch, consisting of some kerosene soaked rags attached to the end of a pole. In this way two men had all the piles burning in about half an hour.

No sooner were all the fires started than a heavy deluge fell, lasting for one half hour. However, none of the heaps were completely extinguished, but after being allowed to smoulder for two hours, some of the smaller fires, which did not have enough heat to consume all the material, were lifted with a fork and placed on other heaps which were burning more vigorously.

The fires which were started at 3 P.M. were attended to and drawn together until 5:30 P.M. At 7 P.M. some of the smaller fires were again amalgamated and the orchard was still undergoing a fairly dense

fumigation at 9 P.M. Atmospheric conditions between 4 P.M. and 9 P.M. were ideal, there being no wind at all, with the air warm and damp.

Results. Immediately before fumigation and again one day later, a determination was made at three different points in the orchard of the number of apple sucker adults that could be counted from the ground in 5-minute periods in order to gain an approximate idea of their relative abundance before and after treatment. The results were as follows:—

1. *Before Fumigation*

(a) 5 individuals in 5 minutes.
(b) 110 individuals in 5 minutes.
(c) 235 individuals in 10 minutes.

2. *One Day After Fumigation.*

(a) 5 individuals in 3 minutes.
(b) 3 individuals in 5 minutes.
(c 0 individuals in 5 minutes.

Live individuals were somewhat more numerous in the tree tops than indicated in the foregoing, but they were for the most part inactive.

On a sheet of 18 sq. ft. area spread beneath the tree previous to fumigation there fell 361 apparently dead apple suckers. Fifty of these eventually showed some signs of life and were confined on apple seedlings, but only twelve of these regained their normal activity.

Counts were made five days later in the orchard from the same points as before with the following results:—

10 individuals in 5 minutes.
14 individuals in 5 minutes.
23 individuals in 5 minutes.

At the time this increase was thought to be due, at least partially, to recovery, but later experiments indicated that the percentage of recovery is low, while reinfestation from surrounding areas takes place with comparative rapidity. This particular block being surrounded on all sides with heavily infested trees, every condition was favorable for prompt reinfestation. It may be noted that in Block B, the pest was apparently as numerous as ever three weeks after treatment.

SUMMARY OF TREATMENT.

Area of orchard, 1½ acres.
Number of trees, 41.
Number of fires, 36.
Date of application, Sept. 1, 1921.

Materials:

Tobacco leaves and stems, 400 lbs.
Tobacco dust, 100 lbs.
Wet weeds, 50 lbs.
Kerosene, 1 gallon.

Labor:

1 horse and wagon, 3 men,	1 hour
Mowing weeds,	1 hour
Lighting fires, 2 men,	½ hour
Attending fires, 1 man,	2 hours

Cost per 50 trees: $16.17

Detailed Cost of Treatment

400 lbs. Tobacco stems and leaves @ 2c per lb.	$8.00
100 lbs. Tobacco dust @ 3c per lb.	3.00
1 gal. Kerosene @ 40c per gal.	.40
1 horse, 1 hr. @ 25c per hr.	.25
7 hrs. labor @ 25c per hr.	1.75
	$13.40

General Observation on Fumigation.

The immediate effect of the fumigation with tobacco waste in the open air without the use of tents was much greater than would have seemed possible. Were it not for the prompt reinfestation of the treated areas, we would be tempted to prosecute this phase of the work much more vigorously.

Were it possible to develop sufficient cooperation to fumigate a large area at one time under careful supervision, it might, even under these circumstances, be worth while to attempt further such treatments on a large

scale. The probability of securing the co-operation of every single grower in any large area is not very great, but it might be done. The treatment of the orchards late in August after the period of maximum activity of the apple suckers has ceased, but before egg-laying begins is a promising line of inquiry.

There is another important item to consider, however, viz., that of cost. At the costs given, which we believe with proper organization could be reduced considerably, the operation might be economically carried out. It was discovered, however, upon attempting to renew our supply of tobacco waste, that it would now cost double the figure given. This supply had been obtained several years ago and since that date the price of the product has increased and the cost of freight still more so. The freight charges alone from Montreal, where our supply is obtained, even when the material is purchased in carload lots, so increases the original cost, that the expense of the treatment under 1920 conditions was prohibitive.

It might therefore be well at this point to summarize the results of our experience in the carrying out of the operation of fumigation.

Our experiments indicate that 360 lbs. to the acre of waste tobacco, free from incombustible material, will give good control under favorable conditions. It is unnecessary to use hay as a starter for fires, as they burn quite well without such assistance. We have used damp vegetation to prevent the material from blazing up, but it seems likely that watering with a sprinkling can would have the same effect and would shorten the work. The fires can be ignited most rapidly by the use of a torch, rather than with matches.

Numerous small fires are better than a few large ones. Where the latter are used on a still day, the smoke has a tendency to ascend directly upwards and be lost. It is of advantage also to have a number of heaps held unlighted in reserve, so that in the event of a wind suddenly arising or changing its original direction, these reserve heaps many be transferred to the windward side of the orchard.

The fall of rain during the process is not particularly to be feared, since our experiments show that once started, the fires keep on burning, even through a heavy shower. It is not advisable, however, to leave heaps out long unlighted in the rain as this will result in the extraction of a large part of the nicotine. The fires will have to be drawn together several times, as there is a tendency for a part of the outside of the heap to remain unconsumed. In fact, it is advisable to pick up the smaller fires by means of a fork and to add them to those burning more vigorously.

The cost will, of course, vary with the locality, particularly with its proximity to a cheap source of waste tobacco. With tobacco waste at 2 cents per pound, we believe the entire operation could be performed at a cost not exceeding from $8.00 to $10.00 per acre, which compares favorably with that of other treatments.

It must be borne in mind, however, that success could only be hoped for in isolated orchards, or in cases where the operations covered a very large area. Furthermore, to further lessen the amount of reinfestation, it would be advisable to defer treatment as late as possible before oviposition, viz., at the end of August. It is possible that were this done, important reinfestation would not occur.

CONTROL OF THE APPLE SUCKER IN THE ADULT STAGE, 1921.

In August, 1921, an attempt was made to exterminate, as nearly as possible, the adult apple suckers from certain heavily infested blocks of trees with a view to determining the extent and rate of reinfestation from adjoining trees. It was not intended as an experiment in the control of the insect. Nevertheless, as the results proved to be of some interest from this standpoint, brief summaries of the experiments themselves and the effect of the treatment given are here presented. It is unnecessary to describe the different blocks of trees, as this has been done in discussing the reinfestation experiments (1921).

Spraying. Experiment *A*.

Material, 1 pint Black Leaf 40 to 100 gals. of water.
Amount per 30 year old trees, 6½ gals.
Date of application, August 8th, 1921.
Cost per 50 trees, $12.60.

No. of P. mali seen on foliage before treatment.	No. of P. mali seen on foliage 3 hours after treatment.
70 in 5 minutes	20 in 5 minutes
89 " " "	35 " " "
106 " " "	50 " " "(top)
Avg. 89 " " "	35 " " "

Counting was commenced two hours after spraying and 944 adults were found on a sheet area of 190 sq. ft. As adults appeared to be still falling, the sheet was gone over again two hours later, when an additional 353 individuals were found, making a total of 1297. None of these recovered.

The counts for number of live suckers were made within a couple of hours after spraying and the large number seen gave us the impression that the application had been a waste of material. Five days after, however, only two adults could be found in the same period of time. It would appear, therefore, that not sufficient time had been allowed to get full effect of the nicotine and had we delayed our first count twelve hours, as was done with the other treatments, the number of live adults on trees would have been much smaller with a corresponding increase in quantity of dead found on sheet. A careful examination of this orchard showed that the treatment given had been surprisingly effective. This treatment might be added to the last regular spray, delayed until all the insects had reached the adult stage, but under ordinary conditions this would be of no practical value owing to reinfestation.

Dusting. Experiment B.

Material, 3% nicotine sulphate, 97% white clay.

Amount used per tree, 5 lbs. @ .06c.

Application, 3/5c.

Date of application, August 8th, 1921.

Cost per 50 trees, $16.50.

Counts of Infestation.

Before fumigation, 122 individuals seen in 5 minutes; 12 hours later,

1 individual seen in 5 minutes
2 individuals seen in 5 minutes
4 individuals seen in 5 minutes, (top of tree)

Individuals found on sheet, area 190 ft., 2653.

Per cent adults recovering normal activi 0.

The material in this experiment was plied at 6 P.M. after a drizzling rain, wet foliage consequently holding the d to its maximum capacity. As the eveni was dark and cloudy, counting was not co menced till 6.30 the following morning, fore the normal insects became acti However, as none of those found on the sh ever recovered, it is unlikely many were l during the night.

Having had no previous experience the use of dust during the adult stage of t psyllia, the material was applied liberal to ensure some results. This naturally mak the cost unduly high. With a view to remed ing this, another nicotine dust was tried, f the results of which see Experiment "C".

Dusting. Experiment C.

Material, 3% nicotine sulphate, 10% h drated lime, 87% marsh mud.

Amount per tree, 3¾ lbs.

Date of application, August 12th, 1921.

Cost per 50 trees, $11.40.

Counts of Infestation.

Before dusting (average) 100 individua seen in 5 minutes.

12 hours later (average) 2 individual seen in 5 minutes.

No. of individuals found on sheet area 190 sq. ft., 5142.

Percent individuals recovering norma activity, 0.

The summary above speaks for itself Comparing the average infection prior t application and number found on sheet wit same data for the other treatments, it woul look as though this were the most deadl material used so far. In view of the smal number of insects found on trees followin application, it is probable that smalle amounts of dust might give satisfactory co trol for a less outlay.

Fumigation. Experiment D.

Area, 1500 sq. yds.
No. of trees, 50.
Time laying out and lighting, 1 man, 1½ hours.
Date of application, August 9th, 1921.
Material, 200 lbs. tobacco stems and 2 pints nicotine sulphate.

Cost:—

200 lbs. tobacco stems		.02c..	4.00
2 lbs. nicotine sulphate	@	$1.60 ..	3.20
1 man, 1½ hrs.	@	.30c..	.45
			$7.65

Cost per acre, $24.49.

The fires were started at 8 P.M., the maximum amount of smoke lasting 45 minutes and then diminishing till 9 P.M., by which time most of the material was consumed. Counting of adults on the sheet was commenced at 6 A.M. next morning, but it is very doubtful whether any recovered sufficient activity during the night to fly away. The number found on the sheet (laid on ground), the area of which was 190 sq. ft., was 3620, of which very few showed any signs of life whatever.

Before fumigation counts were made of visible apple suckers on accessible foliage and also 12 hours after fumigation with results as follows:

Prior to fumigation, 85 individuals in 5 minutes,

12 hours later, 1 individual in 5 minutes.
1 individual in 5 minutes.
1 individual in 5 minutes.
(top of trees).

Tobacco stems alone when dry have a tendency to blaze up to a considerable height, so each heap was dampened by using a watering can, the nicotine sulphate being added to the water. By this means also, a very even distribution of the nicotine sulphate was secured. The fumes from this combination are much stronger than from tobacco stems alone, as dead insects were found on foliage 60 feet distant from the nearest fire.

While the control obtained from this fumigation is probably as good as can be obtained, the cost of nicotine is so high that its use as a fumigant, at least in this crude manner, cannot be recommended, more economic results being derived from this material as a liquid spray during the nymphal stage of the pest.

Fumigation. Experiment E.

Area, 1600 sq. yds.
No. of trees, 15 (about 50 years old).
Time, laying out and lighting, 1 man 1½ hours.
Date of application, August 10th, 1921.
Material, 70 lbs. tobacco stems.
60 lbs. tobacco dust (50% incombustible)
1 gal. pyridine.

Cost:—

70 lbs. tobacco stems	@	.02c....	$1.40
60 lbs. tobacco dust	@	.03c....	1.80
1 gal. pyridine	@	1.00	1.00
1 man, 1½ hrs.	@	.30c....	.45
			$4.65

Cost per 50 trees, $15.50.

Counts of Infestation.

Before fumigation, 144 individuals seen in 5 minutes; 12 hrs. later,
a) 9 individuals seen in 5 minutes,
b) 9 individuals seen in 5 minutes,
c) 13 individuals seen in 5 minutes, (25 yds. from nearest fire)
d) 6 individuals seen in 5 minutes (top of high tree)

Avg. 9 individuals seen in 5 minutes.
Found on sheet of 190 sq. ft., 3120.
Per cent adults recovering normal activity, 0.

The pyridine used in this experiment was inflammable, so that to prevent the heaps soaked with the material from bursting into flame, they were covered with damp weeds. It is impossible to tell from this experiment, how much, if any, of the effects secured was attributed to the pyridine, but it is probably not great, as in a later experiment in which the same substance was applied as a vapor by means of a blower, it did not appear that this material was one-tenth as deadly as nicotine. We have given $1.00 per gallon as the price of this material, though in large quantities it could be obtained for about one-half that sum.

Some of the trees used in this experiment are too high to be sprayed satisfactorily. To the leeward of the block, dead insects could be found on the ground and weeds fifty yards from the nearest fire.

General Observations. These experiments showed that the adult apple suckers are, contrary to our expectations, quite susceptible to either spraying, dusting or tobacco fumigation in the adult stage. The treatments given to blocks A and C are not excessively expensive when compared with others, and were it not for the fact of re-infestation, they might be applied advantageously, but at present they cannot be recommended. A summary of all the experiments is given in the accompanying table (No. 1). The results of experiments conducted in 1922 will be published elsewhere.

TABLE NO. 1.

Summary of Control Experiments in Adult Stage.

Block	Treatment	Material Used	No. of Specimens counted in 5 minutes before Treatment	No. of specimens counted in 5 minutes after Treatment	No. of dead insects per sq. ft. on sheet	Amount of material per tree	Cost per tree
A.	Spray	Nicotine Sulphate 1 pt. to 100 gals. water	89	35	6.8	6½ gals.	.25
B.	Dust	Nicotine Sulphate 3% White Clay 97%	122	23	14.0	5 lbs.	.33
C.	Dust	Nicotine Sulphate 3% Hydrated Lime 10% Marsh Mud 87 %	100	2	27.0	3¾ lbs.	.23
D.	Fumigation	Tobacco Leaf Nicotine Sulphate	85	1	19.0	4 lbs. tobacco, 1½ 1½ oz. Nicotine Sulphate	.49
E.	Fumigation	Tobacco stems Tobacco dust Pyridine	144	9	16.0	4 2/3 lbs. tobacco stems 4 lbs. tobacco dust ½ pint pyridine	.31

The counts on the block were made too soon after treatment. Later observation showed that the actual results were very satisfactory.

Dairy Commissioner Visits Australia and New Zealand.

The Honourable Mr. Motherwell, Minister of Agriculture, announces that in pursuance of his policy of progress and development of the agriculture of this country he is sending two dairy experts to New Zealand and Australia to look into the methods and practice being followed in the dairy industry in those Dominions. The experts in question are Mr. J. A. Ruddick, Dairy Commissioner for Canada, and Mr. W. A. Wilson, Manager of the Saskatchewan Co-operative Creameries and President of the Canadian Produce Dealers Association.

Both these gentlemen are familiar with Canadian dairying and both have within the year been looking into the status of Canadian dairy products on the British market. The reports of these two experts and the observations and recommendations of Dr. J. H. Grisdale, Deputy Minister of Agriculture, who returned from Great Britain a few weeks ago, all point to the need for prompt and energetic action if Canada is to make any progress on the British Market, or even if she is to hold her own.

It is proposed to spend four or five weeks in New Zealand and about a fortnight in Australia. It is hoped to have the recommendations of these experts in time to put them into effect this coming season in part at least.

The delegation will look into milk production and manufacturing in both butter and cheese, but more particularly into grading, marketing and shipping methods in which these antipodean competitors of ours excel.

Potato Seed Treatment Tests in Manitoba.

G. R. BISBY, J. F. HIGHAM, H. GROH.

Rhizoctonia is exceedingly common on potatoes in Manitoba. The injury to the sprouts often results in missing hills, and the fungus continues to cause damage throughout the growing season by attacking the roots, stolons, and underground stems. Usually a considerable percentage of the tubers will be found, when dug, to bear black scurf surface blemishes. The prevalence of black scurf on the tubers is often such as to preclude seed certification where a limit of ten per cent. of affected tubers is fixed.

The abundance of Rhizoctonia in Manitoba is undoubtedly largely explainable on the basis of soil temperature. Richards (1) has shown that severe damage to the potato plant by the fungus occurs at soil temperatures below 21°C. When the senior author reached Manitoba in 1920, he at once proceeded to make tests of various seed treatments in the hopes of being able to prevent the disease. Previous experience elsewhere had given results similar to those reported by Howitt (2), and showed that corrosive sublimate was valuable in reducing injury from Rhizoctonia on the growing crop, and in lessening the number of tubers bearing black scurf sclerotia. Three years tests in Manitoba have, however, given results different from any the authors have seen reported, and indicate that the black scurf problem is different here than in many areas.

During 1920 Beauty of Hebron potatoes were treated with solutions of corrosive sublimate, formaldehyde, and copper sulphate. It is unnecessary to list here in detail the results obtained. The results as regards scab were good; an average of 18.3 per cent. of the tubers from untreated seed showed scab, and only an average of 4.6 per cent. of the tubers from treated seed were scabbed. For black scurf the data could not at the time be interpreted; an average of 56.7 per cent. of the tubers from treated seed bore black scurf, and an average of 57.6 per cent. of the tubers from untreated seed were scurfed. Although the results were best with corrosive sublimate (average 46.4 per cent. scurf on progeny of affected and treated tubers), the difference even here was not great. Each treatment plot in 1920 consisted of three rows; two rows of each plot were dug Sept. 1-8, and the third Oct. 8-9. In every case but one the later diggings showed more black scurf than the earlier; the averages of all plots dug Sept. 1-8 was 51.1 per cent. black scurf, and of those dug Oct. 8-9, 58.7 per cent. scurf. The significance of date of digging was, however, not obvious from the 1920 data.

In 1921 a replicated series of treatment plots was planted. The plots were dug from time to time during the autumn. The first check plot (from seed with black scurf, no seed treatment) dug on Aug. 20, gave the surprising result of only 7.5 per cent. black scurf. Table 1 gives the results in full.

It will be seen from Table 1 that seed treatment had practically no influence on the amount of black scurf present; the limiting factor was the date of digging, as shown by the following list:

Dug	Aug.	20	Progeny	bore	7.5	per	cent.	black	scurf.	
"	"	26	"	"	54.0	"	"	"	"	
"	"	30-31	"	"	56.3	"	"	"	"	(Average)
"	Sept.	1-2	"	"	70.8	"	"	"	"	"
"	"	6-7	"	"	88.5	"	"	"	"	"
"	"	8-9	"	"	94.4	"	"	"	"	"
"	Oct.	13	"	"	93.5	"	"	"	"	

Table 1. Results of treating potatoes at M.A.C. in 1921.

Plot	Seed used	Treatment used	Time Treated	Date Dug	Number Clean	Number Scurfed	Number Scabbed	Total Number#	Weight lbs.	Percent Scab	percent Black scurf.
1	B.Scurf	None		Aug.20	181	29	179	387	130†	46.3	7.5
2	B.Scurf	None		Aug.26	61	180	175	333	115	52.6	54.0
3	B.Scurf	None		Oct.13	11	358	183	383	116	47.8	93.5
4	Clean	None		Aug.30	91	155	114	319	117	35.9	48.6
5	Scurf	$CuSo_4$	1:150, 2Hrs	Aug.31	124	147	2	273	104	.7	53.8
6	Scurf	$CuSo_4$	1:150, 1hr	Aug.31	89	196	21	295	113	7.1	66.4
7	Scurf	$CuSo_4$	1:150, ½hr	Sept.1	69	231	10	303	110	3.3	76.2
8	Scurf	$CuSo_4$	1:100, ½hr	Sept.1	88	201	12	294	103	4.1	68.4
9	Scurf	HCOH	1:320, 2hrs	Sept.1	92	207	9	306	120	2.9	67.6
10	Clean	$HgCl_2$	1:1000, ½hr	Sept.2	99	233	3	335	122	.9	69.5
11	Scurf	$HgCl_2$	ditto	Sept.2	79	215	3	297	117	1.0	72.4
12	Clean	none		Sept.9	23	300	58	336	122	17.3	89.3
13	Scurf	As 5		Sept.9	8	322	7	335	108	2.1	96.1
14	Scurf	As 6		Sept.9	27	329	12	361	115	3.3	91.1
15	Scurf	As 7		Sept.9	5	342	9	348	118	2.6	98.3
16	Scurf	As 8		Sept.8	12	313	28	320	100	8.7	97.8
17	Scurf	As 9		Sept.8	21	353	37	376	124	9.8	93.9
18	Clean	As 10		Sept.7	41	312	17	362	114	4.7	86.2
19	Scurf	As 11		Sept.6	51	286	16	343	108	4.6	83.4
20	Scurf	None		Sept.6	3	307	150	320	101¶	46.9	95.9

The total is not necessarily the sum of preceeding columns, because some tubers bore both scab and black scurf.

† Border row. ¶ Not a border row.

Some scab present on seed used. Rows uniform in length and number of hills. Early Ohio variety used, treated on May 7, cut and planted on May 16 and 17.

This shows clearly that in 1921 black scurf developed rapidly on the potato tubers, apparently beginning about the middle of August and reaching a maximum about Sept. 9.

Good results were again evident in the case of scab, and were unaffected by date of digging. The following summary may be made:

Average per cent. scab from affected	untreated tubers,	4	plots	48.4
" " "	partly clean	" " 2	plots	26.6
" " "	all treated tubers	14	plots	4.0

The yield results may be compared in Table 1. The treatment did not exert a marked effect upon yield: the lowest yield was obtained for copper sulphate 1:100, and the next lowest for copper sulphate 1:150 for two hours. The best yield was obtained from seed treated with formaldehyde, the next best from clean tubers planted without treatment; followed by the yield from seed treated with corrosive sublimate. The differences are not great. Lessened yield may result from treated sprouted tubers, as has been noted in various other regions, but proper treatment of unsprouted scurfed seed may be expected to increase the yield somewhat.

Considerable field and laboratory experimentation at the Manitoba Agricultural College demonstrates that copper sulphate is not safe for treating in the spring. The well known toxicity of this poison to algæ and certain fungi, and its comparative cheapness, made it appear that it might be valuable for black scurf and scab treatment. It was found, however, that for a number of reasons this chemical is unsatisfactory. When dissolved in any but the purest water, part of the copper is precipitated out, and the strength of the solution is therefore uncertain. When 4 grams of $CuSO_4$ were dissolved in 1000 cc. tap water, a chemical test by Dr. C. B. Clevenger gave only 3.432 gms. in solution; in the case of water from the Red River, only 3.354 gms. remained of the 4; in water from a well more than a quarter of the copper was precipitated out, leaving only 2,925 gms. in solution of the 4 gms. put in. Tests made by treating tubers bearing sclerotia with $CuSO_4$ solutions of various strengths in tap water gave the following results: the sclerotia on potatoes were not killed by a two hour treatment in solutions of the strengths 1:1000, 1:750, 1:250, and were not all killed at a strength of 1:175 for two hours. At a strength of 1:100 for one-half hour no sclerotia were found to grow when placed on culture media. In six tests of $HgCl_2$ 1:1000, growth of sclerotia was found in only one case. The laboratory and field tests showed that the strength of

$CuSO_4$ solution required to kill sclerotia is such as will frequently injure the eyes of tubers.

During 1922 tests were made of planting as well as harvesting tubers at different dates. Treated and untreated tubers were planted May 5, 15, 22, 26, 29; June 1, 10, 20, and July 1, and some of each were dug Sept. 1, 10, 20; Oct. 4 and 13. In 1922 again there was no difference to be noticed between the amounts of black scurf on the progeny of treated and of untreated seed tubers. All potatoes dug Sept. 1 showed an average of 39 per cent. black scurf, those dug Sept. 10, 43.3 per cent; Sept. 20, 61.3 per cent.; Oct. 4, 71.4 per cent; Oct. 13, 82.8 per cent. The average per cent. of black scurf on potatoes planted May 5 and dug at different dates was 73; May 15, 80; May 22-26, 76; May 29 - June 1, 81; June 10, 61.2; June 20, 39.2; July 1, 42.5. In 1922, therefore, potatoes were already considerably affected with black scurf by Sept. 1. Black scurf could not be avoided this year by late planting, since the date of planting at which reduction in black scurf became evident was too late to be practicable.

In all the above data, the figures for percentage. of black scurf were obtained by washing the tubers with water and counting as scurfed all tubers which showed sclerotia when damp, since the sclerotia are much more evident on damp than on dry tubers. The figures for black scurf are therefore higher than they would be if a count were made of dry and more or less dirty tubers in a bin. It may also be remarked that the sclerotia tend to increase in size and conspicuousness as well as in numbers on tubers left in the soil.

Three years' test at Winnipeg allow the following conclusions to be drawn for these years and the conditions of the experiments:

1. Sclerotia of Rhizoctonia developed in about as great numbers on the progeny of treated as of untreated tubers. 2. Tubers dug early (late August to the first of September) had fewer sclerotia than those left longer in the soil. 3. Black scurf could not be practicably avoided during 1922 by late planting. 4. Seed treatment was found during the two years in which counts were made, to reduce the amount of scab. 5. A slight increase in yield was obtained from treating scurfed tubers with formaldehyde or corrosive sublimate. 6. Copper sulphate was not found to be dependable or safe for seed treatment.

Manitoba potato growers may be able to avoid some of the trouble from black scurf on potatoes by digging as early as is practicable. Seed treatment was valuable for scab at Winnipeg and might have reduced the amount of black scurf in certain other areas or in other soils of the province. The treatment of seed tubers, if unsprouted, is a sound sanitary measure, and the writers would apply it at least to the plots grown for seed. But the fact remains that soil infestation with Rhizoctonia under Manitoba conditions is such as to render the tubers extremely liable to considerable infection with black scurf, an infection which cannot be avoided by seed treatment. Fortunately, good yields are obtained in the Province in spite of Rhizoctonia. Black scurf does, however, make the certification of potatoes rather difficult in Manitoba.

REFERENCES:

1. Richards, B. L. Pathogenicity of *Corticium vagum* on the potato as affected by soil temperature. Journ. Agr. Research, 21: 459-482, 6 plates, 1921.

2. Howitt, J. E. Experiments in the control of Rhizoctonia or black scurf of potatoes. Sci. Agr. 1, 256. 1921.

NOTES

M. B. Davis (Macdonald '12), Chief Assistant in the Division of Horticulture at the Central Experimental Farm, is taking graduate work in horticulture at the University of Minnesota.

Major R. L. Wheeler has been appointed Fruit Transportation specialist in the Dominion Fruit Branch, succeeding G. E. McIntosh who was recently appointed Dominion Fruit Commissioner.

P. H. Vezina (Laval '20) formerly at St. Valier, P.Q., is now on the teaching staff of the Oka Agricultural Institute at La Trappe.

Herbert Groh (O.A.C. '08) has been transferred from Winnipeg to the Central Experimental Farm, Ottawa, in the Botanical Division.

Field Problems as Related to Dairying.

BY H. RIVE,

Department of Agriculture, Victoria, B.C.

The field problems encountered in a consideration of Dairy Production and Manufacture are many and so varied in nature as to demand attention from Animal Husbandman and Agronomist, Bacteriologist and Chemist, as well as from Dairy Fieldman and Manufacturer. Of Production, the main phases are: Economic Production, Quality of raw product and Marketing. Of Manufacture: Supply and Quality of raw product, Methods of Manufacture, Quality of finished product and Marketing. Considering only the field problems and ignoring at this time a separate consideration of marketing we have Economic Production and Quality of Product as concerning directly both producer and manufacturer.

Economic Production

Economic Production depends today, as never before, on: Selection of cows according to yield, supply of suitable foodstuffs, and methods of feeding.

The means available to every dairy farmer now-a-days for selection by yield are well known. The full benefits of official or semi-official tests or of grade cow-testing association work will not be experienced until attested records of production (for grade or purebred) are demanded as a matter of course when purchase is contemplated and until we recognize in the show rings the dairy function of the dairy cow to a greater extent than we do now. Considering that without good production a dairy cow is without value, criticism of and awards for conformation, however desirable, should be confined to known producers and their offspring in temporary classes. That is to say, if the various record systems and the information they afford concerning production are valued at their true worth, exhibition prize lists these many years should as a logical consequence have read: For animals with records of at least three hundred, four hundred or five hundred pounds of fat, etc., and for neither cows nor bulls of any breed or ty without records of production behind th unless conformation is esteemed unduly apart from performance.

Several countries in Europe recogniz this condition, which on this side of the A lantic has been overlooked through vario causes, many years ago. The result is th while on this continent are to be found t highest producing individuals of probab all the dairy breeds, the average producti of milk is about three thousand pounds p cow per annum as compared with five tho sand for Denmark, six thousand five hundr for Switzerland and seven thousand poun per cow per annum for the Netherlands.

The supply of suitable foodstuffs is so esse tially a problem of the field husbandm that it need not be considered here.

Feeding methods bear so important a pa in all record work and in all productio that here we have indeed a problem and series of problems. For thirty years more animal rations and feeding metho have been discussed in the agricultural co lege classrooms, in agricultural textbooks a in the agricultural press of the country; y one may well ask what method, if any, followed by the farmers of today in the feeding operations. Much work has bee done in the older countries, as on this co tinent, in digestion experiments and a va amount of information has been secured i regard to foodstuffs and their effect on th production of animals. Of late years muc research has been done in the determinin of heat and energy values until today considerable library could be assembled works on animal foodstuffs, their valu and methods of feeding.

In spite of this accumulation of knowledg and having regard particularly to the fee ing of dairy animals, we still lack a simpl popular and even reasonably easy method transforming the conclusions arrived at int rules and principles that can be grasped an

utilized in daily practice by our farmers. The closer investigation we bestow on average practice, the more certainly we find that a farmer's own experience, assisted by a store of more or less related facts he has acquired from various sources, determine his practice, but of commonly accepted definite method of feeding dairy cattle, with or without scientific backing, there is none.

The subject is admittedly complex, intricate and difficult, but one is forced to the conclusion that there is reluctance to avail oneself of the experience of others—also that agricutural teachers as a class have given the farmer more scientific explanation than real guidance and more theory than helpful rule. Here is a real task and a problem, to construct a channel whereby the necessary conclusions from the information accumulated can flow to the average farmer and by him be utilized. The more an individual studies the subject set before him the better, but investigators cannot be said to have successfully completed their work if the average farmer must know the sciences together with theories concerning foodstuffs in abstruse terms in order to give his animals the proper care and attention.

A number of the older countries, however, have managed to spread broadcast through their agricultural communities certain known facts, with the result that each and every farmer, though his total knowledge may be small, yet works with something of definite assurance and definite rule towards an average of practice and production that is vastly superior to ours.

Investigations, experiments, researches and theories have been soundly warranted enough to add immensely to the total of information, but meantime a method of utilizing results, conclusions and values in terms that are simple, intelligible, expressive and adaptable, the farmer still lacks.

Quality of Product.

Quality according to solid content:—A milk of a given per cent. fat and S. N. F. (solids not fat) possesses a higher or a lower value according to the market in which it is offered for sale. The fitness on several counts of the milk of some breeds of dairy cattle for buttermaking; the closer approximation to standards required for market milk and milk for condenseries and cheese factories of the milk of other breeds; the greater per cent. of total solids in certain milks and the lack of economy in using these alone for market milk or for cheese-making; these things are as well known as are the logical outlets for the milks of the different breeds. A milk too rich in fat for market purposes means extra handling and standardizing, causing extra expense. A milk too low in fat brings more or less the same result. What breeds of dairy cattle should we therefore recommend? Something more than enthusiastic sentiment and personal fancy should guide the advice. What system of payment to apply to all milks received and do justice?

This is an old problem in the neighborhood of all the large cities, though a newer one locally, and plans have been devised to deal with it.

(1) With a price per lb. of butterfat, based on a 3.5% milk, of say 50c, giving $1.75 per cwt., 4 or 5 cents may be allowed for each .1 above. Thus for instance, for 3.8% milk per cwt. would be received @ 4c $1.75 (.3 x 4) = $1.87, and so on.

5.5%=$1.75 plus .80 = $2.55, per cwt.

How deal with milk below standard in fat? Deductions in the same way but in a larger proportion are sometimes made. A sweet cream price may be paid. These are but instances of many methods.

(2) Milk may also be graded and be valued at from 3 to 6c per lb. fat for B-class milk. Grades are determined by Bacteria, Acidity, Sediment, Flavor and Temperature. For grade A will then be received 5c per cwt. extra. For grade C, 5c per cwt. less than grade B.

The conclusion is inevitable that there is to be expected (regardless of predisposition here or there) in the neighborhood of our most active milk markets a growing tendency on the part of farmers to select those breeds whose milks are best suited to the use to which they are purposed.

Grade of Raw Product—Grade, as we have mentioned, may be based on Number of bacteria, Amount of acidity, Amount of sediment, Flavor and odor, Temperature.

To obtain a good quality of the raw product is a big undertaking for the producer. It also means everything to the manufacturer, whose success depends largely on this.

The work must be done by the producer, but wonderful stimulation by the fieldman, as representing improved methods, the manufacturer and to a much greater extent than at present by the general public which does not know what constitutes a good milk and is unwilling to pay for extra cost in its production.

There are many practices and devices, the observance and presence of which on a farm contribute immensely toward the securing of a good product. There is much talking and writing of suitable and sanitary buildings, clean cows, utensils and methods which is always timely and constitutes good dairy propaganda. There exists also an abundance of regulations Municipal, Provincial and Federal, the purpose of which is to ensure a clean product. Until, however, the average dairy farmer, throughout the various operations that are included in the production of milk, remembers that it is intended as a food for human consumption and cares for it accordingly, much progress is not to be expected. It is neither possible nor desirable for the authorities to mount guard over the dairy farmer's every day work. It is also true that no amount of elaborate equipment nor processing nor skill of the dairy manufacturer can atone for lack of care and cleanliness on the part of the producer.

Grading determines the relative cleanliness, flavor and keeping quality of the milk or cream received. Ascertaining the bacterial content, which is mainly responsible for the degree of acidity upon which in turn depends the keeping quality, influencing also the flavor and odor, is the work of a bacteriologist, a specially trained and equipped man whose services are out of the question for every day purposes and can be used occasionally only. Determining the percentage of acidity can be done more easily and quickly and the same may be said of sediment, but unless special and extra help is on hand even these operations take too long to be carried out in the daily practice of most dairy factories.

The temperature of a sample of milk or cream when delivered constitutes a reliable if indirect indicator of bacteria, acidity and keeping quality, and can be ascertained without loss of time. Let the manufacturer offer a premium for milk or cream delivered below a certain degree of temperature (varying with certain seasons) and let him discount for it ever so slightly when received above a certain other degree. Good must then result for low temperatures influence beneficially bacterial content, flavor and odor, acidity and keeping quality. As regards the farmer, this amounts to no more than the oldest of advice to cool soon and keep cool, but relatively few dairy manufacturing establishments discriminate between milks on the score of temperature when received. Yet there is no other operation as simple to perform that will have as far reaching results.

The effect of not subjecting to correct temperatures, by the producer at the proper time, though under sanitary conditions, is often as disastrous to the manufacturer as though actually unclean conditions were permitted.

B. C. Cow Breaks World's Record in Butter Yield.

Vancouver, Jan. 24.—British Columbia today boasted the greatest butter producing cow of any breed or any age, in the world's history.

Agassiz Segis May Echo, owned by the Experimental Farm at Agassiz, B.C., completed a 365-day record with 30,886 pounds of milk, yielding 1,338 pounds of butter fat, which equals 1,673 pounds of butter.

This is 86 pounds of butter greater than the production of the former champion, Bella Pontiac, of Brantford, Ont.

A Seattle cow and the famous California cow, Tilly Alcartara, produced more milk than the Agassiz cow, but neither approached her in butter fat yield.

Yesterday, her last day of the test, she gave 63 pounds of milk. She is a huge animal weighing almost 1,800 pounds, and has put on a hundred pounds of flesh in the last year.

Meetings of Scientific Societies.

THE CANADIAN BRANCH OF THE AMERICAN PHYTOPATHOLOGICAL SOCIETY.

The Fourth Annul Meeting of the Canadian Branch of the American Phytopathological Society was held in the Biological laboratories and class rooms at Macdonald College, Ste. Anne de Bellevue, P.Q., December 7th and 8th, 1922, in conjunction with the Quebec Society for the Protection of Plants. The following papers were read and discussed:

Address—Prof. Wm. Lochhead (Pres. Q. S.P.P.)

La campagne contre les sauterelles dans Quebec in 1922—G. Maheux.

Plant Diseases of Western Quebec in 1922—B. T. Dickson.

The natural control of the Green Apple Bug by a new species of Empusa—A. G. Dustan.

Control of the Onion Maggot in 1922—W. J. Tawse.

The Dominion Entomological Service—A. Gibson.

Disinfection et parcelles—O. Caron.

The pollination of certain vegetable plants by insects—R. C. Treherne.

Wood v. Fungi (Demonstration slides—— R. J. Blair and J. D. Hale.

Welcome—Principal F. C. Harrison.

Address by Dominion Fruit Commissioner—G. E. McIntosh.

The Past and Future of Plant Pathology—Dr. Melville T. Cook, State University, New Jersey.

Report of the Plant Disease Survey—F. L. Drayton.

Cultural characteristics of certain root-rot Fusaria—T. G. Major.

The present status of the White Pine Blister Rust in Canada—A. W. McCallum.

Red Branch of Conifers—J. H. Faull.

Two plant diseases new to Ontario—J. E. Howitt.

Control of Oat Smut—B. T. Dickson, R. Summerby and J. G. Coulson.

Five years' experiments in the control of Oat Smut—J. E. Howitt, R. E. Stone.

Control of Raspberry mosaic—J. F. Hockey.

Balsam Rusts—H. P. Bell and J. H. Faull.

Peony diseases—J. G. Coulson.

Root-rot and wilt of canning peas—R. E. Stone.

Distribution of Ribes and Cronartium ribicola in Ontario—G. H. Duff.

Soft rot of Iris—J. K. Richardson.

Blue-stem of the Black Raspberry—J. F. Hockey.

Plant pathology in public schools—W. A. McCubbin.

Smut control experiments with copper carbonate dust and other substances—W. P. Fraser and P. M. Simmonds.

Treatment of wounds in tree surgery—R. E. Cossette.

The bronze birch borer—C. B. Hutchings.

Preservative treatment of farm timbers—J. H. Coderre.

A contribution to our knowledge of the tree destroying fungi of the Vancouver forestry district—N. L. Cutler.

Abstracts of the papers dealing with plant diseases will appear in an early issue of "Phytopathology". The address by Dr. M. T. Cook will appear in full in the Journal of the Quebec Society for the Protection of Plants.

R. E. STONE,
Secretary-treasurer.
O.A.C., Guelph, Ont.

THE ENTOMOLOGICAL SOCIETY OF ONTARIO

The Annual Meeting of the Entomological Society of Ontario for the year 1921-22 was held at the Ontario Agricultural College, Guelph, on Friday and Saturday, November the 24th and 25th.

The general meetings of the Society were held in the lecture room of the Department of Entomology. The dinner on Friday evening was held in the College cafeteria after which the members and visitors adjourned to the Common Room of Mills Hall for a smoker and social evening, when the President, Mr. Morris, read an interesting paper on a collecting trip to Rondeau Park and Point Pelee.

The meetings were well attended by members of the Society and by visitors from the Ontario Agricultural College and others.

The following programme was presented:

Moving Picture Film—The European Corn Borer—Ontario Provincial Motion Picture Bureau.

The Spread of the Corn Borer in 1922, (10 minutes)—L. S. McLaine, Dominion Entomological Branch, Ottawa.

Further Notes on the Life History of the European Corn Borer, (10 minutes)—G. J. Spencer, Ontario Agricultural College, Guelph.

Revised Control Measures for European Corn Borer, (15 minutes)—H. G. Crawford, Dominion Entomological Branch, Port Stanley.

Discussion on European Corn Borer.

The Economic Importance of Insects as Food for our Common Whitefish—Dr. W. A. Clemens, University of Toronto, Toronto.

The Haunts and Habits of Somatochlora, (15 minutes)—Dr. E. M. Walker, University of Toronto, Toronto.

Mechanical Devices used in Control of the Strawberry Root Weevil, (15 minutes)—W. Downes, Dominion Entomological Branch, Pictoria.

Provancher, His Life and Works, (10 minutes)—George Maheux, Department of Agriculture, Quebec.

Observations on the Oviposition of *Senotainia trilineata* V. der Wulp. (Tachinidae), (5 minutes)—C. H. Curran, Dominion Entomological Branch, Ottawa.

Insects of the Season in Quebec, (10 minutes)—George Maheux, Department of Agriculture, Quebec.

The Relationship of Biological and Taxonomic Studies of Syrphidae (Diptera), (10 minutes)—C. H. Curran, Dominion Entomological Branch, Ottawa.

Insects of the Season in Ontario, (10 minutes)—Prof. L. Caesar, Ontario Agricultural College, Guelph, and W. A. Ross, Dominion Entomological Branch, Vineland Station.

Notes on *Frankliniella tritici,* Fitch—R. C. Treherne, Dominion Entomological Branch, Ottawa.

Biologic Notes on two Buprestid Beetles (*Agrilus ruficollis* and *A. politus*), 10 minutes; lantern—C. B. Hutchings, Dominion Entomological Branch, Ottawa.

The Outbreak of Grape Leaf-Hoppers (15 minutes)— W. A. Ross and W. Robinson, Dominion Entomological Branch, Vineland Station.

The Feather Mite, a new Poultry Pest (10 minutes)—Prof. L. Caesar, Ontario Agricultural College, Guelph.

Some Observations on the Oviposition of *Hypera punctata,* (5 minutes)—H. F. Hudson, Dominion Entomological Branch, Strathroy.

Recent Developments in the Dominion Entomological Service, (20 minutes lantern)—Arthur Gibson, Dominion Entomologist, Ottawa.

The Sunflower Maggot, (10 minutes)—J. E. Brink, Ontario Agricultural College, Guelph.

Recent Work on the Rose Chafer, 15 minutes)—W. A. Ross and J. A. Hall, Dominion Entomological Branch, Vineland Station.

The Occurrence of the Potato Seed Maggot *Hylemyia trichodactyla* in Ontario, (5 minutes)—G. H. Hammond, Dominion Entomological Branch, Ottawa.

The officers of the society were re-elected save that Mr. J. A. Flock was elected curator in place of Mr. Spencer.

A. W. BAKER,
Secretary-treasurer.
O.A.C., Guelph, Ont.

ACADIAN ENTOMOLOGICAL SOCIETY

Eighth Annual Meeting Held at Amherst, N.S., Thursday, Dec. 14, 1922.

The immense value of studies in the control of insect pests by natural means, such as parasitic insects and diseases in the case of some at least of our worst pests, was brought out very clearly in a paper preented by Mr. A. G. Dustan of the Dominion Entomological Branch to the entomologists from New Brunswick and Nova Scotia gathered at the Annual Meeting of the Acadian Entomological Society held at Amherst on December 14th. Papers of equal interest, regarding the control of insects by artificial means, were presented by Mr. A. Kelsall of the Dominion Entomological Branch and Dr. W. H. Brittain of the Truro Agricultural College, while the control of forest insects was discussed by Dr. Tothill and Messrs. A.

H. MacAndrews and A. B. Baird of the Dominion Entomological Service. These papers will all be published in full in the "Proceedings" of the Society for 1922.

A short business session was held at which the doings of the past year were discussed and plans outlined for 1923. Last year's officers were all re-elected as follows:

Honorary President, Dr. A. H. McKay, Halifax, N.S.
President—Mr. Wm. McIntosh, St. John, N.B.
Vice-President, Dr. W.H. Brittain, Truro,N.S.
Sec.-treas.—Mr. A. B. Baird, Fredericton, N.B.
Asst. Secretary—Mr. W. E. Whitehead, Truro, N.S.
Member of Committee, Dr. Edna Mosher, Kempt Shore, N.S.

The next annual meeting will probably be held in St. John, N.B., and at least one field meeting will be held during the summer months either in New Brunswick or Nova Scotia.

Under the title of "Some Notes on *Entomophthora sphaerosperma*, a Fungal Parasite of the Apple Sucker", Mr. Dustan gave a detailed account of the life history, distribution, and means of dissemination of this important disease, which he was last year successful in spreading artificially in the orchards around Wolfville and Grand Pré and which has saved the fruit growers of the Valley at least half a million dollars. The Apple Sucker was accidentaly imported from Europe some three or four years ago, being first discovered in the vicinity of Wolfville in 1919, but, due to its phenomenal powers of increase, it spread very quickly and is now found in five counties of Nova Scotia. It is not found in any other part of North America at the present time but will doubtless reach New Brunswick within a very few years. Mr. Dustan's remarkable success in connection with the artificial spread of this disease marks the beginning of a new era in this line of endeavour.

The value of Sulphur Dust as an insecticide was discussed by Mr. Kelsall and the results of experiments carried on by him go to show that Sulphur Dust does have a decided insecticide value and when applied as a fungicide, either alone or in combinations, quite a number of insects are killed by it. In connection with his other paper on "The Use of Aluminum Sulphate in place of Copper Sulphate in Insecticide-Fungicide Combinations," Mr. Kelsall gave a very interesting account of the results which have been obtained recently in the production of cheaper and better insecticides. This is of extreme importance to the fruit growers and potato growers, since it is now practically impossible to grow either fruit or potatoes without spraying, and every dollar taken off the spray bill increases the profit to the grower to that extent. Mr. Kelsall is also working on the production of spray mixtures that may be used with greater safety to the foliage of treated plants, and Aluminum Sulphate, while apparently not as good a fungicide as Copper Sulphate, is extremely valuable from the standpoint of lessening the burning effects of arsenical sprays. It has the additional advantage of being a very cheap material.

The paper by Dr. Tothill gave a summary of very important results which have been obtained from the studies in the natural control of forest insects, which have been carried on from the Dominion Entomological Laboratory at Fredericton for the past ten years. These studies have been carried on chiefly in New Brunswick but were rounded out by four summers of intensive study in British Columbia and Alberta. They have shown that in the case of at least two of our most serious forest insect pests, the Spruce Budworm and Tent Caterpillar, the devastating outbreaks which have occurred within recent years have been due to our upsetting the balance of Nature in the forests by unscrupulous cutting, coupled with forest fires.

He said in part— "In the primeval forest bequeathed by our forefathers there were no important outbreaks of insects because Nature had established a natural balance that prevented any one insect becoming too abundant. There were no pure stands of fir or spruce or poplar on a large scale, there were numbers of insectivorous birds, and insect parasites were uniformly distributed and destroyed vast quantities of spruce budworm and other caterpillars.

"For a century we have been working in direct opposition to Nature and in the course of our ordinary lumbering methods have finally succeeded in destroying this delicately adjusted balance. The ancient mixed

stand has largely gone. Pine has been eliminated, white spruce has disappeared over great areas, and the kind of red spruce known twenty-five years ago as timber has gone. Natural seeding of the valuable trees has been interfered with by removing the seed trees, and in place of the ancient forest that was the pride and glory of our forefathers, our forest is coming to be dominated by a weed tree, balsam fir. Pure, or nearly pure, stands of fir, of poplar and of spruce now exist over immense areas, giving an increased food supply for spruce budworm (balsam budworm would be a better name) and for tent caterpillars. At the same time, the numbers of our insectivorous birds have diminished in a dangerous way because most of them can only nest to good advantage in a mixed stand where the supply of insect food is regular in amount and varied in kind. Also, the insect parasites have been reduced to a precarious existence because instead of there being a regular supply of insect food for them, there is now a plentiful supply at the time of an outbreak followed by starvation years in which many of the most important ones are exterminated over areas as large as New Brunswick.

"The only remedy worth considering is one that will give permanent results at a minimum cost. We must work with Nature and not against her so as to restore the natural balance. Without any planning, we have taken a century to destroy the balance; with planning it should be possible to re-establish the balance within the life-time of living man.

"To decrease the amount of fir, we could make it more profitable to put it on the market by dispensing with diameter limit regulations and stumpage rates. At the same time we could increase the diameter limit on spruce a little so as to reduce the cut and also to encourage natural seeding.

"To encourage mixed stands we could sow seeds of the valuable trees along the network of twitching trails in connection with every logging operation. Further, we could attempt to reforest such recently burned areas as have sufficient soil by sowing seeds upon the snow in winter, as this is the only time that such areas are readily accessible.

"As to the invaluable parasites, we could assist Nature to keep them uniformly distributed by establishing colonies where the are needed.

The larch sawfly is a special case in whic notable results could be expected by intr ducing parasites from Europe. The sawf was imported from Europe and its inse parasites were left behind. If the Europea balance is not brought about in Canada witl in the next few years, the sawfly is likely t decimate our tamarack as soon as the stan comes to maturity, just as it did a third c a century ago.

"Close studies of the spruce budwor and other outbreaks have shown that we ar now reaping the reward of having done vi lence—inadvertently, it is true—to the way of Nature. It is not too late to ally ourse ves with Nature and build up types of fores that would be proof against the insec scourges that at present are decimating ou forest resources."

Professor Brittain gave a very interestin paper, summarizing the results of continue experiments on the control of the Cabbag Root Maggot. This is one of the most ser ious pests attacking cabbages, cauliflowers radishes and early turnips, and Dr. Brittai has found that it may be controlled very ef fectively by two applications of Corrosiv Sublimate, 1-1000 dilution. One applicatio should be made when the seed is sown an another a week to 10 days later, care being taken to saturate the ground thoroughly.

The insect pests of the year in Nova Scotia were reviewed by Professor Brittain and the New Brunswick pests by Mr. R. P Gorham. Special attention was called t the very unusual outbreaks of garden Cut worms and Flea Beetles in both provinces and the ravages of the Tent Caterpillars Larch Sawfly and Birch Leaf Skeletonizer i New Brunswick.

Mr. A. H. MacAndrews of the Fredericto Laboratory gave a very interesting accoun of how the Pine Bark Aphid, which was so noticeable as a white, waxy-like mass o the pine trees this past spring, was almost entirely wiped out of existence by Ladybird Beetles, assisted to a slight extent by two other species of beneficial insects.

A much more serious situation was described by Mr. A. B. Baird in his paper on the Natural Control of the Larch Sawfly and Larch Case-Bearer in New Brunswick. Unlike the above-mentioned aphid, which is a

native insect, these pests were introduced from Europe, probably about the beginning of the 19th century. Very little is known regarding the history of the Case-Bearer in New Brunswick but it has been doing considerable damage during the past two or three years, and while several parasites have been reared from it in Europe, only one has been reared in New Brunswick.

We have records of two outbreaks of the Sawfly in New Brunswick previous to the present one and the more serious of these, which occurred in 1883 to 1885 and destroyed nearly all the tamarack in the province, is well remembered by many of the older lumbermen and others. At the present time the tamarack supply is just reaching merchantable size and during the past summer at least 75 per cent. of the larger trees were stripped by the Sawfly larvae. Studies of the insect over considerable areas in the province indicate the probability of a much more severe outbreak next year, and unless something unforeseen happens, our supply of tamarack will be entirely destroyed once more within the next few years.

A. B. BAIRD, Fredericton, N.B.
Secretary-Treasurer.

Les Matières Minérales des Plantes.

JOSEPH FERLAND, B.S.A.

Division Fédérale des Semences, Québec.

Généralitiés.

Tous les végétaux organisés contiennent des matiéres minérales. Ce sont les éléments qui donnent à la sève ses propriétés vitales et permettent à la plante de se développer et produire des fruits.

Les matières minérales constituent les cendres après calcination du végétal. On peut les doser en pesant le résidu que l'on obtient en brulant la plante à la plus basse température nécessaire pour obtenir une combustion complète.

Dans les plantes cultivées, les matières minérales forment généralement de 5 à 10% de la matière sèche, rarement plus. Cette quantité représente ce qui a été enlevé du sol. Le reste provient de l'atmosphère; c'est la matière organique ou valatile qui se dégage sous l'action de la chaleur.

La proportion de matières minérales est à peu près constante dans une même de plante, cependant elle peut varier un peu avec l'âge de la plante, le climat et la nature du sol. Ainsi dans les trèfles de différents endroits on trouve une proportion de 6 à 8.5% de cendres dans la matière sèche.

Les matières minérales ne sont pas distribuées uniformément dans toutes les parties de la plante. Les feuilles et, en général les parties les plus actives, en contiennent une plus grande proportion. Pour le mais, par exemple, on a trouvé les quantités suivantes dans les différentes parties:

Plante mûre,	5.8%
Racines,	3.5
Feuilles,	8.1
Tige entière	6.6
Grain,	1.4

Eléments des cendres.

Les cendres des végétaux sont composées de Potassium, de Sodium, de Calcium, de Magnésium, de Fer, de Phosphore, de Soufre, de Chlore, de Silice avec une petite quantité d'Aluminium, de Manganèse et de Bore. Ces matières sont toujours en combination dans la plante, soit à l'état de sels soit avec les éléments qui forment la matière organique. Elles ne sont jamais à l'état libre de base ou d'acide quoiqù'on les exprime ainsi.

La plupart de ces éléments ont un role physiologique particuler à remplir dans la végétation, mais tous ne sont pas indispensables; quelques une peuvent être sans nuire au développement de la plante. Leur présence semble plutôt accidentelle; à cause de leur solubilité dans l'eau du sol. Tels sont le Sodium, le Chlore, la Silice, l'Aluminium. Les éléments essentiels, c'est-à-dire ceux qui prennent une part directe dans la production des tissus de la plante sont; le Potassium, le Phosphore, le Soufre, le Fer, le Magnésium et le Calcium. On ne peut les supprimer sans nuire au développement de la plante.

Fonction des eléments minéraux.

Le Potassium est un élément essentiel, des plus importants et des moins variables. Il est presqu'uniformément distribué dans toutes les parties de la plante, mais on le trouve un peu plus abondamment dans les feuilles. Il est absorbé du sol dès le début de la croissance.

Le potassium est nécessaire à la production et au transport des hydrates de carbone dans la plante. Il régularise l'acidité de la sève en formant quelquesfois des sels organiques, comme le bitartrate de potassium dans le raisin. Au temps de la formation des grains, le potassium a un mouvement rétrograde dans la plante. Dans certains cas, une petite partie retourne au sol. Le potassium a une grande influence pour augmenter la vigueur de la plante. C'est un élément qui est susceptible de manquer dans le sol.

Le Sodium ressemble au potassium dans ses propriétés chimiques. Il n'existe pas en trés grande quantité dans la plante et n'est pas nécessaire à son parfait développement.

Le Calcium est toujours présent dans les plantes: il est indispensable à la matirité. Certaines plantes s'en montrent particulièrement exigeantes, tels sont les trèfles, les pois, les fèves, la luzerne qui en requièrent une très grande quantité relativement. Des accumulations de chaux sont trouvées dans plusieurs plantes feuillues, particulièrement les trèfles. Le calcium se trouve en plus forte proportion dans les feuilles. Il a pour fonction d'aider la formaiton des membranes cellulaires; aucune nouvelle cellule ne paut être formée sans calcium. On voit l'importance de cet élément dans la formation des tissus nouveaux. Le calcium est assimilé au début de la croissance. Il donne de la dureté, de la consistance à la plante. Dans les céréales, environ les neuf dixièmes de la chaux sont dans la paille et un dixième dans le grain. On observe que les récoltes qui croissent sur un sol qui a eté chaulé sont généralement bien nourries et plus résistantes à la gelée.

Le Magnésium est un élément essentiel à la végétation. Il se trouve en plus petite proportion que la calcium dans la plante, mais il y en a trois fois plus que la calcium dans la graine. Le magnésium est assimilé plus lentement que le calcium. Il est nécessaire surtout au moment de la formation de graines auxquelles il donne la fécondité. Des graines qui ne contiennent pas de magnésium ne peuvent pas germer. Une petite quantité de magnésium entre dans la composition de la chlorophylle, matière indispensable à la vie des plantes.

Le Phosphore se trouve dans toutes les partis de la plante; c'est un élément essentiel. Il sert à la formation et au transport des corps protéiques. Le phosphore est nécessaire dés le premier stage de la végétation. Dans le blé, 80% du phosphore est absorbé dans les 50 premiers jours de la croissance. Il existe surtout dans les graines où on le trouve de 60 à 75%. C'est une substance qui fait souvent défaut dans le sol.

Le Soufre est un élément essentiel mais on le trouve en petite quantité les cendres parce qu'une partie se dégage avec la matière organique pendant la combustion. Il entre dans la composition chimique de l'albumine et de plusieurs matières azotées.

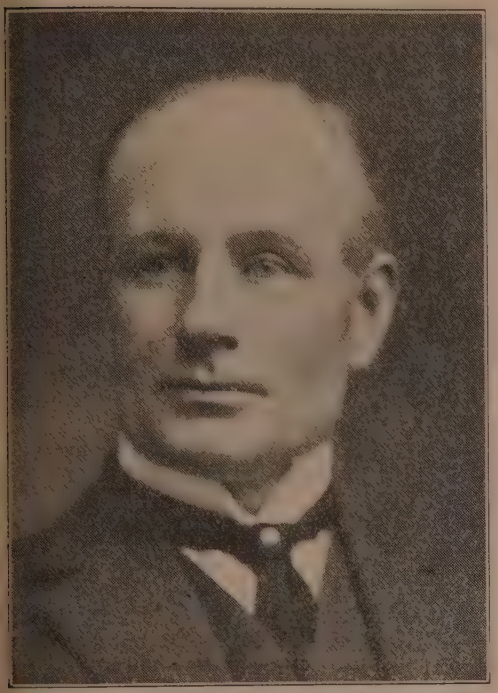
Le Chlore n'est pas essentiel à la plante. On le trouve en petite quantité et surtout dans les parties inférieures, racines, tiges. Son rôle n'est bien défini et ne présente pas d'importance.

La Silice se trouve surtout dans les parties les moins actives de la plante et dans la tige. On lui attribue la fonction d'apporter de la rigidite à la plante, mais on a pu faire croître du blé parfait sans silice. Son absence n'est pas la cause de la verse. La silice n'est pas essentiel à la plante et la quantité en est toujours suffisante dans le sol.

L'Aluminium n'est pas essentiel à la plante, mais on en trouve une petite quantité dans les cendres. Son rôle n'a pas d'importance dans la végétation.

Les éléments minéraux qui sont susceptibles de faire défaut à la plante pour qu'elle puisse donner une bonne végétation et un fort rendement sont le phosphore et le potassium. La chaux est quelquefois nécessaire au solm, mais c'est pour remplir le rôle d'amendement plutôt que celui d'engrais. Le plâtrage des terres qui produit quelquefois un très bon effet sur les légumineuses en particulier, pourrait laisser supposer une action favorable par le soufre qu'il apporte à ces plantes riches en matières azotées.

L. H. Newman is New Dominion Cerealist.



Announcement has been made of the appointment of L. H. Newman as Dominion Cerealist, to fill the position vacated by Dr. Charles E. Saunders one year ago.

L. H. Newman was born at Merrickville, n eastern Ontario, in 1881. He spent his outh on the farm, and still owns a general arm near Merrickville, where he is making specialty of pure seed and purebred Holtein cattle.

He graduated from the Ontario Agricultural College in 1903, and since that date as done specialist training, without seekng or obtaining advanced degrees, at the owa State College, the University of Illiois and Cambridge University. He has also one research work in plant breeding at valöf, Sweden.

In 1912, as a result of his investigations nd studies abroad, he prepared a volume ntitled "Plant Breeding in Scandinavia", 93 pages, which was published by the Canlian Seed Growers' Association. It is ineresting to note that this volume has recently been translated into the Japanese langage.

For the past 18 years, Mr. Newman has been Secretary of the Canadian Seed Growers' Association, with headquarters at Ottawa. In this position he has been engaged chiefly in promoting the growing and handling of registered seed in Canada, and has come into close personal contact with farmers and professional workers throughout the Dominion. He has been Honorary Secretary of the C.S.T.A. since its organization in 1920, and is also a member of the American Society of Agronomy, the American Genetic Association and the Ottawa Field Naturalists Society.

Mr. Newman was married in 1921, to Miss Gertrude Robinson of Guelph, Ontario, who was well known as a member of the staff in the Field Husbandry Department at the O.A.C. They have one child, a daughter, born in November, 1922.

In view of his life-long practical experience, together with his wide knowledge of experimental work being conducted in Canada, the United States and Europe, and the close personal connections which he has established during the past twenty years, Mr. Newman is peculiarly fitted for the carrying on of his new duties as Dominion Cerealist. We wish him every success and many years of useful service.

NOTES.

J. G. Rayner (Manitoba '13) Director of Extension Service at the University of Saskatchewan, has accepted the responsibility of acting as chairman of the Entertainment Committee for the next Annual Convention of the C.S.T.A., which is to be held at Saskatoon from June 20th to 23rd next. The two branches at Regina and Saskatoon will work together in planning all details concerning the Convention.

Lt.-Col. Robert Innes (Macdonald '11), Agricultural Director of the Soldier Settlement Board, sailed from Vancouver on December 15th, for India. He will enquire into the possibilities of securing settlers for Canada from approximately 2,000 Imperial officers who are now demobilizing. He is not expected to return to Ottawa before August, 1923.

Concerning the C.S.T.A.

APPLICATIONS FOR MEMBERSHIP.

Geo. F. Boyd (Saskatchewan, 1922, B.S.A.) Limerick, Sask.

A. R. Brown (Saskatchewan, 1922, B.S.A.) Saskatoon, Sask.

Joseph Coke (Toronto, 1916, B.S.A.; Wisconsin, 1922, M.S.) O.A.C., Guelph, Ont.

H. J. Crowe, Regina, Sask. (Associate).

Sidney R. Curzon (Toronto, 1912, B.S.A.) O.A.C., Guelph, Ont.

Arthur Davey (Toronto, 1917, B.S.A.) O.A.C., Guelph, Ont.

C. C. Eidt, (Toronto, 1921, B.S.A.) O.A.C., Guelph, Ont.

A. J. Gaudet, (St. Joseph's, 1902, B.A.) St. Joseph, N.B.

A. Goguen, Moncton, N.B. (Associate)

J. F. Hockey, (McGill, 1921, B.S.A.) St. Catharines, Ont.

R. R. Hurst (Toronto, 1922, B.S.A.) O.A.C., Guelph, Ont.

R. G. Knox (Toronto, 1920, B.S.A.) O.A.C., Guelph, Ont.

A. S. Kyle, Regina, Sask. (Associate).

T. H. Lund (Toronto, 1912, B.S.A.) O.A.C., Guelph, Ont.

A. W. Mason (Toronto, 1905, B.S.A.), O.A.C., Guelph, Ont.

T. W. Morse, R.R. 2, Port Credit, Ont. (Associate).

D. R. Sands (Toronto, 1915, B.S.A.; Wisconsin, 1922, M.S.) O.A.C., Guelph, Ont.

A. A. Scales (Toronto, 1918, B.S.A.) St. Eleanor, P.E.I.

J. S. Shoemaker (Toronto, 1922, B.S.A.) Big Rapids, Mich.

Donald B. Shutt (Toronto, 1922, B.S.A.) Winnipeg, Man.

J. C. Steckley (Toronto, 1911, B.S.A.) O.A.C., Guelph, Ont.

George Thimens, Sussex, N.B. (Associate).

W. Waldron, Dept. of Agriculture, Regina, Sask.

NOTES

The present address of Dr. Charles E. Saunders, formerly Dominion Cerealist, is 32 Rue Monsieur le Prince, Paris, France.

W. H. Smith (O.A.C. '12) District Representative at Athens, Ontario, has been transferred to Chatham, Ontario.

H. G. Bell (O.A.C. '05), has recently entered the commercial field and is now with the Hamilton Advertising Agency at Hamilton, Ontario. He was formerly Director of the Crop and Soil Improvement Bureau of the Canadian Fertilizer Association.

GRADUATE SCHOLARSHIP FUND

Board of Trustees.

The following members of the Canadian Society of Technical Agriculturists have agreed to act as members of the Board of Trustees, and will constitute the complete Board, with the exception of one French speaking member, to be appointed:

Dr. M. Cumming, Secretary for Agriculture and Principal of the Nova Scotia Agricultural College, Truro, N.S.

Dr. F. C. Harrison, Principal of Macdonald College, Ste. Anne de Bellevue, P.Q.

J. B. Reynolds, President of the Ontario Agricultural College, Guelph, Ont.

V. W. Jackson, Professor of Botany, Manitoba Agricultural College, Winnipeg, Man.

Dr. W. P. Thompson, Professor of Biology, University of Saskatchewan, Saskatoon, Sask.

E. A. Howes, Dean of the Faculty of Agriculture, University of Alberta, Edmonton, Alta.

Dr. L. S. Klinck, President of the University of British Columbia, Vancouver, B.C.

The General Secretary of the Society, Mr. Fred H. Grindley, will act as Executive Secretary of the Board of Trustees and the work of securing donations to the Fund is being undertaken immediately.

The Credentials Committee, which will assume the responsibility of selecting the successful applicants, will not be appointed until April 15th next. The personnel of the Committee will depend largely upon the nature of the applications received.

A full page announcement of the Graduate Scholarship Fund appears in the advertising pages of this issue.

EDITORIAL

This issue is made up almost entirely of apers and addresses given at a Convention f the Canadian Society of Technical Agriulturists held at Macdonald College, Ste. nnes, P. Q., on February 1st and 2nd, 923. The Convention was divided into our sessions, at which the addresses covered, n turn, the subjects of (1) Agricultural Reearch and the Farmer, (2) Agricultural Edcational Policies, 3) Agricultural Extension Vork and (4) Agricultural Projects. In the resent issue we have published only those apers which were submitted in manuscript orm at the Convention. Lack of space has ompelled us to omit the addresses on Eduational Policies by Dr. F. C. Harrison, rincipal of Macdonald College, Professor R. Summerby of Macdonald College and H. S. Arkell, Dominion Live Stock Commissioner. These may appear in a latter issue.

An interesting feature of the Convention was the fact that practical farmers had been invited to participate in the programme and to take an active part in the discussions. This provision is too seldom made in programmes arranged by technical workers. The value of an exchange of ideas and viewpoints between these two classes was apparent throughout the meetings at Macdonald College, which continued for two days. The presence of such prominent Quebec farmers as T. B. Macaulay, R. R. Ness, James Winters, Gilbert MacMillan, and a number of others, re-

MACDONALD CONVENTION OF C.S.T.A.
FEBRUARY 1ST AND 2ND, 1923.

From left to right:

Bottom Row—C. E. Petch, W. G. McDougall, W. E. Ashton, W. J. McOuat, Peter Reid, P. C. Armstrong, Gilbert MacMillan, R. R. Ness, Gilbert Arnold, C. H. Hodge.

Middle Row—J. G. Coulson, C. E. Lampman, T. G. Major, E. G. Hood, H. Barton, J. F. Snell, L. G. Heimpel, A. R. Ness, Alex. McTaggart, J. E. McOuat, C. J. Lynde.

Top Row—J. W. Graham, A. Walker, T. G. Bunting, W. J. Tawse, C. Sweet, J. D. Matthews, B. T. Dickson, M. A. Jull, F. H. Grindley, R. L. Conklin, L. C. McQuat, S. R. N. Hodgins, W A. Maw.

sulted in the introduction into the discussions of new problems to which the technical man was perhaps giving insufficient attention, and of new facts concerning agricultural practices of which the farmer was not aware. The meetings were therefore profitable to all who attended them.

One of the principal objects of the C.S.T.A is to make the agricultural profession of increasing service to the industry, and this object can be accomplished in no better way than by bringing progressive farmers and technical workers into closer touch. The attitude of the farmer towards the "scientific" man is becoming more appreciative, and where a critical attitude still prevails it is largely due to a lack of personal contact. This fact was emphasized on more than one occasion at the Macdon Convention.

None of the papers given was technical consequently the present issue is thoroug practical. We believe that this will n with the approval of all our readers, incl ing the members of the C.S.T.A., of wh the majority are engaged in work of a m or less practical nature.

In November, 1922, a special British C umbia number of *Scientific Agriculture* published, the contents of which were obta ed from a C.S.T.A. Convention held in V couver. The present issue results from similar Convention held in Quebec. It expected that other special issues can prepared from the papers and addresses g en at C.S.T.A. meetings in the different p vinces.

EXECUTIVE OFFICERS, MACDONALD BRANCH, C.S.T.A.

Who arranged the Convention on February 1st and 2nd.

(1) M. A. JULL (President; (2) L. C. McOUAT (retiring Secretary-Treasurer);

(3) L. C. RAYMOND (Vice-President); (4) A. R. NESS (Treasurer); (5) J. E. McOUAT (Secretary).

How Research Serves the Agricultural Industry

J. F. SNELL

Professor of Chemistry, Macdonald College, P.Q.

Progress in agricultural practice is and always has been impossible without something of the nature of research—some more than casual observation of natural phenomena and some more than momentary reflection thereupon. Mere tradition, mere doing as father did, obviously does not get us forward. Haphazard variations from the traditional practice, though perhaps in a sense preferable to the stagnation of blind adherence to established ways, are dangerous from the economic standpoint. The chances are against success. There are thousands of wrong ways to every right way. Alterations of practice must be well considered, based on careful comparison of results or on correct deductive reasoning from well established principles. Such comparison and deduction is the essence of research.

In spite of the constant pressure of his everyday duties of multitudinous variety, the farmer with a well-trained eye, a reliable memory and a reflective mind can by virtue of comparison of his own results with those of his neighbors, make substantial improvement in his methods, and real progress is made in this way. But nature is no simple village maid. Her secrets are well kept. Her mysteries are profound. She does not wear her heart upon her sleeve. She demands constant and protracted wooing as the price of intimate knowledge. It is therefore in the true interest of the economy of human effort to have some men devote themselves *fully* to the study of natural laws and even to have them divide and sub-divide the field of science, so that, in addition to a general region of knowledge common to all, there shall be for each a province more particularly his own and, within that province, some corner which he may explore diligently and minutely, until he knows all that man has previously learned about that corner and some things at least which nobody had previously noticed.

To quote a dictionary, research is "diligent, protracted investigation, studious enquiry, especially for the purpose of adding to human knowledge." Such work cannot be done as a mere pastime while plodding behind the plow, resting in the hay mow between loads, driving from town, sitting in slippered ease before the fire-place or even while waiting between delivering a lecture and supervising a laboratory class. It demands diligence, perseverance and time. It is, as the definition states, a *protracted* process.

It is such "studious enquiry" into nature's ways—including some of her ways that have no apparent relation to agriculture—that has made the agriculture of the twentieth century such a vastly different thing from that of the eighteenth and all preceding centuries. It has remodelled this wonderful little planet of ours and all the relationships of men upon it and amongst other changes it has changed our methods of producing, harvesting and exchanging the fruits of the earth and the herds of the fields and the flocks of the poultry yard.

It is to scientific research that we owe all the mechanical inventions that have done so much to add to the economic efficiency of the individual worker on the farm—such labor-saving machinery as is now employed in cultivation, harvesting, threshing and transportation. The steam engine and the gasoline motor embody applications of principles of mechanics, which have been worked out by the patient and careful study of those who have devoted themselves to research—some of them with a view to the useful application of the principles, others out of mere curiosity or determination to know the truth, whether it has useful applications or not. The materials out of which these useful machines are constructed are, many of them, the products of metallurgical processes, dependent upon the chemical actions and suggested by the study of the principles of chemistry.

The steam engine derives its power from the combustion of fuel. This combustion is a kind of chemical action, whose laws have for centuries been understood to a sufficient extent to enable us to keep ourselves warm, though its utilization for the production of work was scarcely thought of until modern science begin to blossom towards the close of the eighteenth century. The gasoline engine derives its power more directly from a chemical reaction, the combustion occurring exposively within the cylinder of the engine, instead of steadily in a furnace outside the engine. Such an engine would never have been conceived had it not been for the chemists' study of the reaction of gases and the nature of explosions. Thus the study of chemistry as well as that of mechanics has contributed and is contributing to the production and improvement of farm machinery.

The electrical inventions which are the pride and glory of the latter half of the nineteenth century and of this still young twentieth century—the telegraph, the submarine cable, the telephone, the electric light, the wireless telegraph and telephone, all trace back to the casual observation of Galvani, an Italian professor of biology, (or of his wife) that a frog's leg kicked when attached to an iron railing by a copper wire. It was Galvani's curiosity to know the reason for this puzzling effect and the interest which his colleague, Volta, of the department of physics took in the same question that led to the invention of the electric battery and therefrom grew the resarches of Faraday, Kelvin, Clerk, Maxwell and Hertz, which led in turn to Morse's and Marconi's and Graham Bell's and Edison's inventions and to those of the numerous investigators who have contributed to the perfecting of our modern means of rapid intercommunication. Photography, another modern marvel, grew out of the observation of chemists that silver salts exposed to sunlight darkened and the subsequent attempts of inventors to produce permanent pictures by combining this knowledge with that derived from other chemical investigations. Out of this has developed the modern art of the photoplay, or moving picture show, which, with the telephone, the wireless outfit and the automobile, is contributing to the removal of such social disadvantages as rural life has had in compa with city life.

In addressing an audience of techn agriculturists it is scarcely necessary to fend research of such a type as has obv application to agricultural practice. study of the conditions under which pl and animals may be grown to best advan in a given locality, the choice of the suitable varieties and breeds, the produc and testing of new varieties, the importa of new plants and animals from for countries and the testing of these to d mine whether they can be successfully economically produced here, the study the habits of wild animals, birds and ins and micro-organisms with a view to their trol in the interests of agricultural pro tion, the analysis of soils, fertilizers, and feeding stuffs, the study of marke methods and other questions of agricult economics,—every intelligent agricult realizes how necessary these are to the fare of our country. And everyone who attempted to deal with a practical prob suddenly thrust upon him—such as a tructive disease, whether of crop or stock soil, with which he has had no experienc must realize how important it is that t should be men prepared to deal prom with such problems, men equipped with necessary general knowledge of the fu mental principles of science, with spe knowledge or experience along the lines the problem in question and with leisure to vote their whole energy to the solution the problem. The farmer without the t nical agriculturists to fall back upon in difficulties is like the mother of a fa without a medical adviser. This I thin recognized by all intelligent men who given thought to the question.

What may *not* be so generally recogn is the advantage and even the necessity supporting all scientific investigation ther it has visible direct bearing on agri ture or not. To the practical man the st of some obscure insect or micro-organ that has never been known to do any mate damage may appear a waste of time. Ne theless such investigation may extend knowledge of life processes in general

ie new-found knowledge may and probably ill find its application in due time. The ve stock breeder and the grain grower ould probably have taken no interest in lendel's investigation of the crossing of gar- en peas. Indeed, the scientific world itself t the time took little notice of the work of ie modest monk. Yet the laws of heredity iscovered by Mendel apply equally to the reeding of cereals and to that of cattle. imilarly, the knowledge of the fundamental ws of electricity which has been built up rgely by such laboratory study as began ith Galvani and Volta has found applica- ons in numerous directions undreamed of y them, much less by their contemporaries less intimate touch with the little know- dge then available.

Imagine a traveller of that day arriving at Canadian farm. He finds the settler en- aged in cutting and burning such excellent mber as can to-day scarcely be purchased any price. In his small clearing, this oodsman-farmer is growing wheat, which lthough intrinsically inferior to varieties nce developed through research, is yielding r more abundantly than modern wheat ops on the same soil. He plows with oxen stead of a tractor or a Clydesdale team. e reaps with a sickle, binds with straw nd threshes with a flail—perhaps even inds his grain in a mortar. The traveller lls him that two Italian professors are ex- erimenting on electricity, finding that it n be generated by dipping two metals in- a bottle of acid. How much interest does ie information excite? The settler probab- wonders why these two professors should ave the time to play with such toys while e has to spend his days in hard labor with ie axe and sickle. Does he suspect that the -called "play" of these foreign strangers their laboratories is going to influence the elfare of his great grandson almost if not ite as much as his own labors in the forest nd field?

Yet to-day by virtue of the work those pro- ssors were then carrying on with the en- usiasm of boys at play, followed by exact- the same kind of work on the part of hundreds and thousands of their successors, his great grandson perhaps gets daily news from all the world; lights his house and barns by turning a button, talks with his neighbors or relatives without leaving his house, drives to town in a motor car driven by a fuel derived from oil which if noticed coming out of the ground would to him have appeared useless or worse, and ignited by an electric battery that is a successor of that invented by Volta, enjoys concerts by the best musicians of the world, and finds means of restoring to the soil something of the fertility of which it has been deprived by the less enlightened farming methods of his fathers.

The point is that the practical man's faith in research must extend far beyond the range of his sight. He must support research even of such character that he cannot see the use of it. The leaders in industry recognize this to-day and great companies, such as the General Electric Company and the Western Electric Company, support research laboratories employing men by the hundred, many of them of course working directly on practical problems, but some of them merely trying to extend human knowledge of nature without much or any consideration of its practical applications. The men at the head of the companies have faith that such knowledge will find its application just as it always has in the past. Such faith is needed also by the farmer and by the technical agriculturists whose work lies in the practical application of the principles of agricultural science or agricultural economics. When such faith prevails the science departments of our agricultural colleges will be far more adequately staffed and far more generously treated in the matter of time and money for research purposes than is now the case. And such faith will have its reward in genuine progress in agricultural practice, the promptness of the realization of the reward depending on the proper organization of contact between the research man, the practical experimenter, the teacher, the extension agent, the agricultural press and the practical farmer.

Agricultural Research Needs in Quebec

B. T. DICKSON

Professor of Botany, Macdonald College.

One hears on every hand statements regarding the research in progress or urgently requiring solution. Why is this? It must be recalled that the gradual trend towards intensive study of vital problems was in progress from the cessation of the period of ultra-exploitation of the soil. The improvement in mechanics of tillage, in transportation, together with increasing world population inevitably demanded improved methods of tillage, better varieties of plants and animals and now better methods of distribution.

During the nineteenth century, while increasing production was a necessity an annual toll, tremendous in total, was taken by insect, fungus and bacterial pests—the Hessian fly, codling moth, rusts, blights, smuts, bovine tuberculosis, hog cholera, etc. Yet this heavy total was not realized unless a catastrophic epidemic occurred, as when late blight ruined the potato crop in Ireland in 1845. What then has brought about such a marked augmentation of interest in and realization of the importance of research in agriculture? There is no doubt that this is one of the few beneficial outcomes of the Great War. Those of us who were overseas can well recall the food shortage—on this continent plenty—in Great Britain and Europe at first ample, then just enough and finally stringent rationing. In fact so serious was the situation that certain officers, of whom I had the honour of being one, were detailed to undertake crop production in the devastated area immediately behind the front. On this Continent production was the slogan and as soon as intensive efforts were made all kinds of major and minor sources of loss became pronounced and public attention drawn thereto. Hence the realization of the need for patient and careful work planned to reduce those losses. It is to be hoped that we do not again suffer from catastrophic losses, but with increasing world population, insidious losses and losses due to competence become increasingly importa

The war woke up Great Britain. A result Rothamsted is now enjoying a lease of life and progress is being made research generally in agriculture by stude in the universities of the United Kingd and Ireland. I was agreeably surpri when Commandant of the First Army Sch of Agriculture in France after the Armis at the keen interest evinced by soldier st ents in research questions.

In the United States there is now in dition to Colleges and Stations, the Natio Research Council, the Crop Protection stitute and the recent Thompson Instit for Plant Research. Here in Canada have the Honorary Advisory Council Scientific and Industrial Research which, view of the fact that agriculture may termed an industry and perhaps scienti allots some part of its available funds agricultural problems.

With this brief review of the situation will ask you to consider for a moment interpretation of the term "research". U derlying the general idea of searching, find that the searching must be careful, di gent, long continued and critical. It is searching after facts and principles and m not be confounded with experimentati which implies the testing or use of alrea ascertained facts or principles. I shall aga refer to this interpretation.

It is usual before making any plans f the future to consider the situation in t immediate present. It is pertinent therefo to enquire what *is* being done in Quebec, f everyone will agree there are plenty of pro lems. Since we are met to consider questio of importance in agriculture in Quebec, it vital to the discussion that our cards be the table. Therefore I say that from t point of view of research, of adding

cientific knowledge for the ultimate benefit f humanity and of our own Province es-ecially, we are not doing anything like hat should be done. We are content to ac-ept findings and facts which were arrived at nd ascertained in distant research centres. Ve do not know of our own knowledge whe-ier they are acutally applicable here or ot. This situation cannot continue and re-ound to the credit of the Province. There ust be reasons for this and I will give what n my estimation constitute the most import-nt.

In the first place the farmers themselves, ith some notable exceptions, are scepti-al. They talk of "new-fangled notions" and it so happens that the investigator is a aboratory man, he is forever damned. The erm "practical" is set up and worshipped ith the result that a man who happens not be essentially of the same nature, yet hose findings are extremely valuable, is old-shouldered and discouraged. There is othing quite so disheartening to a patriotic a term used here without qualification), pa-ent researcher as the continual taunting at only practical work matters. Whence rose those practices, if not as a result of enturies of painful research with inadequate quipment?

In the second place we in our Colleges re handicapped by lack of funds, lack of me, and lack of available men. I do not ntend to convey the impression that here at lacdonald College, we do no research. We o—but not as much as all of us would like do, had we the facilities. Happily there re recent signs of improvement in this re-ject to which I shall allude later.

Thirdly there is not a proper appreciation the Universities of the importance of agri-ulture and the function of the agricultural ollege. This may be due to the more im-ressive results obtained in certain of the o-called "pure" sciences as compared with ie rather utilitarian results in the so called applied" sciences. This is indicated in a ather emphatic manner by salary scales and ne finds that by virtue of the virgin purity f the "Pure" science, one can command a igher scale than by being a member of a aff in an agricultural college. Yet withal agriculture is basic—the most basic in fact—and increasingly complex and scientific. In addition to being paid less we work longer, for most Faculties shut up shop during the summer and the members thereof disappear to summer homes, but in agriculture we go on the year round. Research Professorships are regularly founded but rarely in agriculture whereas they are frequently established in other fields of science.

And finally there is not yet sufficient help for research available from Governmental sources because the matter has not been presented to the Government. If *we* ask help it is sometimes thought to be from an ulterior motive—the urge should come from the farmers themeselves.

Time does not permit of further consideration, so I will deal now with the needs of agricultural research in Quebec, commencing with what in my opinion is fundamental.

1. Atmosphere.

If it is true that the mind of a man is more or less given its trend in early youth, what are we doing to foster a keen appreciation of agriculture? Our academies are headed by B.A's. with excellent training in the classics and inadequate training in Biology. Our boys and girls are sentient beings, surrounded by life of all types and it is surely better that more emphasis be laid on Biology and the spoken languages than on Latin and Greek. This in itself is a great question and I can do no more than express the view that we should eventually develop a more favourable atmosphere for agriculture and agricultural research if Biology (in a broad sense) were more generally and adequately taught in our schools.

Broader vision and greater sympathy with and encouragement for agriculture is requisite in our Universities and Colleges. It is little to be wondered at that by many our higher institutions of learning are regarded as behind the times and more or less fossilized. The basis of thought should be not pure and applied science, but science and the application of science. It can be stated without exaggeration that in no other field, not even excluding human medicine, is science in all its phases and interrelations so fundamental as in agriculture.

In our agricultural colleges we need clear thinking, broad vision and co-operation. It is regrettable, but true that in some cases there is no true appreciation of the fundamental nature of some of the problems and hence jealousies and trespassings eventuate. True co-operation will remove such hindrances to progress. Furthermore there is often a marked tendency to spend the larger appropriations on so-called "practical" departments—a tendency which inhibits the growth of the so-called "inside" departments as though forsooth plant diseases occur only on laboratory tables and insect pests in museum cabinets while soil chemistry is only known in test tubes. I say this with full appreciation of the development of agriculture in this Province, and I say it because such an arrangement is perpetuating a lop-sided agriculture.

The farmers themselves contribute most towards the atmosphere for research whether they know it or not. There is no legislation which demands certain qualifications before a man is allowed to farm. Anyone may farm, but not anyone can farm. Thus it is that there are many farmers just able to get along, with little time and perhaps little desire for consideration of some of the problems they face day by day. It is up to the leaders in farming communities to help educate, encourage and guide their fellow farmers. When the demand for research comes from farmers who clearly appreciate the need for investigations, nothing will stop its fulfillment. Education is needed as to the time factor in research. I refer you again to the interpretation of the term and remind you that one of the underlying principles is long-continued, diligent search. A sudden and serious outbreak brings instant demand for immediate control and if this is not forthcoming one hears the remark—"what is the use of the College anyway?" I was asked to look at some apples recently which were suffering from a serious internal autolysis. So far as I can predict it would take four years to settle that problem satisfactorily. This is only one illustration out of many.

2. Personnel.

The personnel is of three types:—

(a) Research professors.
(b) Teaching professors.
(c) Research students.

We have no research professorships any phase of agriculture and so far as know there is only one in Canada, while the United States there are many. There every reason for such an establishment, a attention should be given to this point farmers, University authorities and Gove ments.

Our teaching professors are here and all cases anxious to do what they can. realize fully that to teach successfully o must actually do some research or check the results of research by experimentation. teacher who merely accumulates book kno ledge in any phase of agriculture is alrea a candidate for Egyptologists. He is me ly a small grade ahead of his students a that only because he is concentrating on so special field rather than attempting to co the whole. But we are handicapped by la of time to handle many problems ourselv Moreover we tend to stale because of the fa that we carry on the year round as stat above. I would suggest here the absolu necessity of sabbatical leave. Two of o staff have received such leave, although was not so-called. It would help material were it a regular institution. I will not spe of the human encouragement resulting fro financial and professional recognition of t work in agriculture, but it is an importa factor.

Research students are coming in increasi numbers and to date without financial assi tance. But under such circumstances th cannot continue on a problem, because of t necessity of getting out to earn more mon to carry them through. It is impossible the present advanced state of agriculture four years of undergraduate training to more than cover the field in agricultu generally and then receive an initiation in some special field. The advanced knowledg the accuracy, the critical view, and the trai ing of the research mind can only come wi graduate study. I would remind you of t

importance of this by an illustration. We all realize the fact that the development of resistant varieties of plants is the soundest method of controlling a disease which is sure to remain with us. Rarely can one happen upon a truly resistant plant at the first attempt. The work entails long study followed by resistance tests by the plant pathologist. The latter must know all about the fungus and the plant in order to test it critically. Such knowledge entails careful microscopic, laboratory, greenhouse and field study. It cannot be done in a short time nor by an untrained man. Consequently we must encourage students to proceed to further training and provide a minimum of financial encouragement in the form of graduate scholarships. No one can do good work if he is hampered by financial worries from week to week. In this respect it is a pleasure to recall the recent encouragement that the Wm. C. Macdonald Tobacco Company Regd, through the interest and broadminded Canadian citizenship of Mr. Walter Stewart, has decided to establish 10 graduate scholarships allocated to students in the different Provinces and tenable at Macdonald College. The C.S.T.A. itself is also looking to the founding of a certain number. This is indeed a step in the right direction but we need more for Quebec from Quebec. The Provincial Government undoubtedly realizes the importance of such scholarships and will in due time establish some.*

Regarding this I might point out that if one takes the Provincial statistics there are approximately 125,000 men between the ages of 25 and 64 engaged in agriculture in this Province. At the rate of 50c per head this would total some $62,000—a small per capita expenditure, but an amount which would be a boon to research in Quebec. I would recommend therefore that progressive farmers use their knowledge and influence to the end that some help be given to this phase of agriculture.

3. Publication of Results.

The two functions of an agricultural college are Teaching and Research, both of which go hand in hand. As our colleges have developed the teaching has become of a dual nature. In the first place, we teach "students in course" and as a result of the widespread need for knowledge, we also teach "students in the field". This latter is usually called Extension work. If the facilities exist for this teaching, the result of research and experimentation studies can then be broadcasted by the extension service. Without doubt the moving picture and radio are to play important roles in future extension teaching. Some means of utilizing the men here in extension publication of principles and facts must be evolved between the farmers, the College and the Provincial Government: that is a problem to be solved.

The publication by actual printing is not so difficult to arrange.

4. Some of the problems.

Were I merely to discuss generalities, little would be gained, but if some of the suggestions now made can be embodied in practice much good may accrue. The following lines of investigation in the different fields are therefore suggested for Quebec as being in my opinion worthy of consideration, and in fact some of them are actually in progress at present.

AGRICULTURAL ENGINEERING.

(1) A survey of Quebec to determine the present status of farm sanitation, protection against lightning, farm building construction.

(2) Farm drainage problems in Quebec.

(3) Studies of the economics of farm machinery.

AGRONOMY.

(1) Variety trials with corn and sunflower to determine their relative value as fodder and silage in areas where cold is a limiting factor.

(2) Investigation into locality limits for high yielding varieties of roots, cereals, etc.

(3) Investigation into the economic advisability of alfalfa growing in the Eastern Townships.

(4) Investigation into soil productivity in Quebec (Co-operation with Chemistry, Physics, Botany, Bacteriology, Entomology, and Horticulture).

(5) Investigation into methods of experiment and the reliability of data to be deduced.

* Since this address was given the Quebec Department of Agriculture has established three scholarships, one each for Macdonald College, the Oka Institute and the School at Ste. Anne de la Pocatière.

A study of the permanent pastures and what to do with them.

ANIMAL HUSBANDRY.

(1) Sunflower silage and corn silage for fattening.

(2) Relative values of protein supplements in fattening cattle, for dairy cattle, and the effects on reproductivity.

(3) Mineral metabolism in farm animals.

(4) Efficiency of various feed constituents in influencing butter fat production.

(5) Physiological studies on milk secretion.

BACTERIOLOGY

(1) Bacteriological investigation on silage of various kinds.

(2) Value of *B. acidophilous* in ripening cream for butter making.

(3) Bacteriological investigation in cheese making.

(4) Relation of bacteria to food decomposition.

(5) Control of bovine tuberculosis.

BOTANY.

(1) Determination of rust resistant varieties of oats for Quebec.

(2) Improvement in methods of smut control of cereals.

(3) Determination of smut resistant varieties of oats.

(4) Study of the factors giving high infection with smut.

(5) Investigations in mosaic, leafroll, stipplestreak of potato.

(6) The importance of clover mosaic.

(7) Studies of the mineral nutrients giving optimum growth in crop plants.

(8) Shade and Forest tree diseases.

CHEMISTRY

(1) Soil acidity studies for Quebec.

(2) Chemical composition of forage crops as affected by soils and climate.

(3) Chemical composition of silages.

ENTOMOLOGY.

(1) Studies in the biology and control of cutworms, cabbage maggot, onion maggot, bot flies, wire worms, apple maggot, etc.

(2) Control of clothes moth.

(3) Study of biology and control of apple borers.

(4) Insects attacking shade and forest trees.

HORTICULTURE.

(1) Studies on the maintenance of productivity in market gardens.

(2) Pruning investigations for Quebec chards.

(3) Orchard culture in Quebec.

(4) Pollenation studies in Quebec chards.

(5) Investigation leading to the devell ment of high yielding varieties of truck g den crops.

POULTRY HUSBANDRY.

(1) Protein requirements in poultry trition.

(2) A study of the effects of prolong light time during the winter on fertili vitality, egg production, etc.

(3) Selection of breeding strains for Q bec.

RURAL ECONOMICS AND SOCIOLOGY.

(1) Farm labour problems in Quebec.

(2) Cost accounting on Quebec farms.

(3) Food production and prices.

(4) Studies on farm organization a management.

(5) Farmers co-operative associations.

(6) Marketing problems.

(7) Rural credit.

(8) Farmers' standards of living.

VETERINARY SCIENCE.

(1) Studies of bovine tuberculosis.

(2) Studies of parasites of livestock.

I need hardly say that these problems a broad and often involve several others, b that is inevitable.

In conclusion may I urge that you gi the question of research and experimentatic your earnest attention both as to the pro lems concerned and the facilities availabl We here are anxious to do something and my opinion the future value of this instit tion lies rather more in what of value ca be ascertained as a result of research an experimentation than in what is taught alon I would remind you that in a statement c the foundation and purpose of Macdonal College one reads:—"The advancement c education; the carrying on of research wor and investigation, and the dissemination c knowledge; all with particular regard to th interests and needs of the population in rura districts."

Some Important Experimental Work in Field Husbandry.

E. S. HOPKINS

Dominion Field Husbandman, Central Experimental Farm, Ottawa.

Since the establishment of the Dominion Experimental Farms in 1886 many radical changes have occurred in Canada in agricultural practice. It was only a few years previous to this date that the grain binder was invented, the introduction of which has greatly facilitated the harvesting of grain, while, in many parts of Canada, the broadcast seed drill was still in vogue. The urgent need in Ontario and Quebec of seeding grain early in the spring was not known until definite experiments showed the enormous increases in yield following early seeding. The best rates of seeding have been established by experimental work throughout the various parts of Canada. Corn as an ensilage crop was practically unknown and it is certainly not saying too much to claim that the Experimental Farms have done a great deal in showing the value of this crop and how it should be cultivated and ensiled. The usefulness of crop rotations has been demonstrated and types of rotations have been tested which are suitable to various kinds of farming. The value of drainage in removing surplus water in Eastern Canada and British Columbia has been demonstrated and improved methods have been learned regarding the best means of accomplishing this. A great increase has taken place in the use of manure and commercial fertilizers as the need of increasing the fertility of the soil in certain parts of Canada has become realized. Finally the invention of the small tractor has enabled the farmer to finish his work when conditions are most satisfactory.

With these great changes, the Dominion Experimental Farms system has constantly striven by the conduct of experimental work to establish farm practice upon an economical and permanent basis. The following statement is a brief outline of some of the more important lines of work.

Date of Seeding Grain

To determine the value of early, medium and late seedings of grain, extensive experiments were started in 1890 at Ottawa. The following table gives the average yield per acre for ten years with oats, barley and wheat, and five years' average results with peas. The first seeding was made as soon as the land was ready to sow and five successive seedings were made at one week intervals.

INFLUENCE OF DATE OF SEEDING ON YIELD OF GRAIN, OTTAWA.

	Oats bus.	Barley bus.	Spring Wheat bus.	Peas bus.
1st sowing	53.3	38.4	17.9	30.4
2nd sowing	59.5	44.2	20.5	33.9
3rd sowing	50.7	33.5	14.1	32.8
4th sowing	45.9	31.5	12.2	29.9
5th sowing	40.2	26.1	10.3	26.3
6th sowing	31.9	23.7	8.6	23.8

The advantage of seeding wheat, oats and barley early in the spring is very outstanding at Ottawa. The best results in every case were secured at the second date of seeding, that is, seven days after the land was ready to sow. After this date, all the grains, with the single exception of peas, very rapidly decreased in yield. Perhaps, with many farmers and especially in fields containing wet pot holes or water courses, their first seeding would more nearly correspond with the second seeding at the Experimental Farm. Inasmuch as the land and the seed were uniform, this decrease in yield was due solely to the late seeding.

The decrease in yield by delaying seeding one week beyond the period which these experiments have shown most favourable has entailed a loss with wheat of 30 percent, with barley of 24 percent, and with oats of 15 percent. By delaying seeding two weeks a loss has been entailed with wheat of 40 per-

cent, with barley 28 percent, and with oats 22 percent. By delaying seeding three weeks a loss has been experienced with wheat 50 percent, with barley 40 percent, and with oats 32 percent. Finally, by delaying seeding four weeks a loss has been suffered with wheat of 58 percent, with barley 46 percent, and with oats 46 percent.

These heavy losses show the urgent need of seeding the crop as soon as possible. They show that the grains should be seeded in the following consecutive order—wheat, barley, oats and finally peas so as to make the most economical use of time during seeding. While this summary of ten years' work was given to the public by the Dominion Experimental Farm 22 years ago and the first reports of it as early as 32 years ago, the results are just as true today as then. These points are facts established beyond all question of doubt, and it is folly for a farmer not to be guided by them; it is folly to learn this by experience.

However, not all parts of Canada have conditions the same with respect to the value of early seeding. While experiments at Ottawa show an enormous advantage from early seeding, and experiments at the Ontario Agricultural College show even greater advantage than at Ottawa, nevertheless, in cooler sections of the country this superiority is not as marked and, in some cases, is not evident at all.

At Nappan, Nova Scotia, and at Agassiz, British Columbia, experiments were commenced in 1891 to gain information on this question. The following table gives the average yield per acre of nine years' work. The first seeding was made as soon as the land was ready to sow and five successive seedings were made at one week intervals:

	SPRING WHEAT		OATS		BARLEY	
	Nappan N.S.	Agassiz B.C.	Nappan N.S.	Agassiz B.C.	Nappan N.S.	Agassiz B.C.
1st seeding	21.6	21.9	55.6	45.3	33.0	22.0
2nd seeding	21.7	22.6	55.9	48.6	29.8	22.8
3rd seeding	20.3	21.6	60.9	48.0	31.4	22.1
4th seeding	18.1	23.9	55.1	47.9	31.9	22.4
5th seeding	19.6	21.4	50.5	51.5	31.4	23.9
6th seeding	18.6	21.8	42.1	56.3	26.0	25.7

At Nappan, N.S., with the single exc tion of the sixth seeding with oats and ley, no difference exists between early late seedings. At Agassiz, B.C., no super ity whatever was gained from the ear seedings. It is possible that in these regi some cultivation might be given the l previous to seeding in order to check growth of weeds.

Rate of Seeding Grain

Experiments were started at Ottawa 1901 to determine the best rates of seed wheat, oats and barley on sandy and c loam soils. As a result of six years' w with wheat and barley and seven years' w with oats, a rate of 1¼ bushels of whe 1½ bushels of barley and 2 to 2½ bush of oats appeared most satisfactory. At C Rouge, Quebec, as an average of eight yea work, a seeding of 2½ bushels of oats w recommended. In view of the excessiv heavy seedings which are practiced in so districts, it is important to know definit from experimental work that smaller se ings are most economical.

Mixed Grains vs. Grains Separately

To determine the economy of sowing ea grain by itself or mixed with one or m other grains, experiments were started Ottawa in 1900. After five years of expe mental work on various types of soil it w found that oats alone gave an average yie per acre of 1976 pounds, barley an avera yield of 1507 pounds, a mixture of one bus el each of oats, barley and peas a yield 1764 pounds, and a mixture of one and o half bushels of oats and one bushel of ba ley a yield of 1597 pounds. From these r sults it was concluded that single pure grai may be expected to give more pounds p acre than mixtures. It may be added th at the present time, the soil being now mu improved in fertility, barley gives som what larger yields per acre than oats.

Somewhat different results, however, we obtained at Nappan, Nova Scotia, where t mixed grain gave a slightly larger yield p acre than the grains sown separately. As a average of thirteen years' work commenci in 1897, a mixture of two bushels of oa

one bushel of barley and one-half bushel of peas seeded at the rate of three bushels per acre yielded 1929 pounds of grain per acre compared with a yield of 1676 pounds per acre of oats seeded alone at a rate of three bushels per acre. Barley seeded at the rate of two bushels per acre gave as a ten year average 1663 pounds per acre.

Supporting our results at Nappan, it is interesting to know that the Ontario Agricultural College has also found a mixture of grains to have given larger yields than grains seeded separately. That institution recommends as the most suitable mixture, a seeding of one bushel of barley mixed with one bushel of oats. On the other hand, the Dominion Experimental Farm at Brandon secured better results with grains seeded alone than in mixtures. In view of these conflicting results, it remains yet to be learned where and under what circumstances each method is most suitable.

Ensilage Experiments

To discover what was the best distance to leave between the rows of corn, extensive experiments were commenced in 1898 at Ottawa, Ont., Nappan, N.S., and Agassiz, B.C. At that time very little was known regarding the use of corn for ensilage and no one knew the best methods of cultivation. Accordingly, experiments were undertaken to learn the best distance to leave between the rows and the following table gives the average yield in tons for the period during which the work was conducted:

YIELDS OF CORN SOWN IN ROWS AT DIFFERENT DISTANCES.

Distance Between Rows	OTTAWA 14 yrs. average	NAPPAN,N.S. 11 yrs. average	AGASSIZ,B.C. 12 yrs average	
			rows	hills
21″ apart	19.4 tons	16.7 tons	19.3	19.5
28″ apart	18.6 tons	16.9 tons	18.0	18.4
35″ apart	17.7 tons	16.4 tons	16.8	16.1
42″ apart	18.4 tons	15.4 tons	15.6	14.8

The above figures show that the yields of corn at Ottawa and Nappan are practically as high when rows are 42″ apart as they are when at closer distances. Moreover, at the 42″ distance the corn is more mature and would contain a larger amount of grain and total dry matter; besides, it is more easily cultivated and hence the weeds kept in check more successfully. At Agassiz, a slight increase was found for the narrower seedings but in view of the disadvantages associated with these seedings as previously mentioned, perhaps a width of about 35″ between the rows would be most satisfactory at Agassiz.

A comparison between seeding corn in rows and hills was commenced in 1894. At Ottawa, the rows were spaced 35″ apart and the plants thinned from 6″ to 8″ apart in the row, while the hills were placed 35″ apart with from 4 to 5 plants per hill. At both Agassiz and Nappan, the rows were spaced 36″ apart and the plants thinned to about 6″ apart in the row, while the hills were placed 36″ apart with from 4 to 5 plants per hill.

The following table gives the average yields for the period during which the work was conducted:

YIELD OF CORN IN ROWS AND HILLS

	OTTAWA	NAPPAN, N.S.	AGASSIZ, B.C.
	18 yrs. average	19 yrs. average	17 yrs. average
Rows	21.0 tons	16.5 tons	15.3 tons
Hills	20.1 tons	15.6 tons	15.6 tons

These results show that there is no difference in yield of corn sown in rows or in hills. It is somewhat quicker to seed in rows and not quite as hard on the corn binder when cutting but in weedy ground the hills offer a much superior opportunity to cultivate the land and certainly do not require as much hoeing.

While corn is now believed to be the most satisfactory crop for ensilage, it may be interesting to know that many experiments were undertaken at Ottawa in the early days to discover what crop gave the largest yield per acre and the most satisfactory ensilage. In addition to corn, ensilage was made from clover, peas, rye, a mixture of oats, barley and peas, a mixture of corn and horse beans, a mixture of corn and pole beans, and a mixture of corn and horse beans to which was added at silo filling time, the heads of sunflowers. The latter mixture was known as the "Robertson Mixture" and was thought to comprise

a combination of crops which would make a more balanced ration. However, none of the crops or mixtures was as satisfactory as the corn and, accordingly, this information was given to the public.

In recent years considerable experimental work has been done with sunflowers alone for ensilage. The results indicate very strongly, indeed, that in cool regions where corn does not grow successfully, sunflowers make a very much superior crop for this purpose. In Northern Ontario, in Northern and Eastern Quebec and in that part of Nova Scotia in which Nappan is situated, sunflowers have proved more satisfactory than corn. Where corn grows satisfactorily, on the other hand, such as in old Ontario and districts in Quebec of similar climate, there is no reason for changing to sunflowers. The percentage of moisture in sunflowers at the time of harvesting is greater than that in corn which often accounts for a larger yield of sunflowers of green material but in reality a smaller yield of dry matter. Thus, at Ottawa in 1922, the sunflower ensilage contained only 15.3 percent of dry matter while the corn ensilage contained 22.6 percent and, while the green weight of the sunflowers was 25.2 tons per acre and the corn only 17.6 tons, nevertheless the dry matter weight was slightly greater for the corn. From our results in 1921 and 1922 at Ottawa, there is no object in substituting sunflowers for corn.

Hay Crops

One of the most outstanding results of many years' experimental work with hay crops at Ottawa is that alfalfa included in the regular hay mixture has markedly increased the yield. The inclusion of only six pounds of alfalfa seed, has always enabled two cuttings of hay to be made and in some years as many as three cuttings. The average yield of hay for the last ten years on the large fields at Ottawa was 3.37 tons per acre while in the Province of Ontario, as a whole, the average yield was only 1.5 tons. It is certainly advisable to include alfalfa in the regular hay mixture, in districts where alfalfa will grow successfully. Sweet clover has not given, at Ottawa, satisfactory results for hay production. Another outstand result in hay production is the value o fertile soil. Hay responds to applicati of manure or commercial fertilizers and likely to give greater financial returns t when these materials are put on cereal cr

To determine which grain would be m suitable as a nurse crop for grass and clo mixtures, extensive experiments have b conducted at Cap Rouge, P. Q., and Ch lottetown, P.E.I. At Cap Rouge slightly s erior results were secured from barley wh at Charlottetown slightly superior resu were secured with oats. On the whole, th does not seem to be sufficient evidence to warrant the selection of either barl wheat or oats for the express purpose of g ting the best nurse crop; it seems advisa to select whichever grain seems most lik to produce in itself the largest monetary turns.

Whether grass and clover seed should seeded at a light rate per acre or at a hea rate is a very controversial question. An periment was conducted at Cap Rouge which a seeding of 8 pounds of Timothy, pounds of Red Clover and 2 pounds of A sike was compared with a seeding of exact one-half this amount. As a result of t years' work, the heavier seeding gave only percent larger yields than the lighter see ing—an increase which cannot be regard as significant. At Charlottetown the indic tions were that a seeding of 7 to 8 poun of Red Clover combined with Timothy a Alsike was quite as satisfactory as larg quantities of Red Clover.

Rotations

The practice of rotating crops in defini order is comparatively recent in agricultur practice. It is true that farmers in old days changed the crops on their field ever few years but the changes were not in d finite order and were not based on a know ledge of any principle. Thanks largely t the work of the Rothamsted Experiment St tion, in England, and to the researches o Hellriegal, who, after more than twenty yea of work announced in 1886 that leguminou plants could draw their nitrogen from th air, the practice of rotating crops becam

tablished on an intelligent basis. It is interesting to remember that wheat grown continuously for many years at Rothamsted elded 11.8 bushels per acre, in rotation ith summerfallow alone, 17.2 bushels, while a four-year rotation of roots, barley, mmerfallow and wheat it yielded 26.9 ushels.

The Dominion Experimental Farms commenced at Ottawa in 1904 an extensive system of rotations, designed to show the most conomical rotations for various types of rming. It was stated at that time that the 00 acre farm had five years previously been ranged into a definite five-year rotation of over hay, timothy hay, grain, corn and oots, and grain, and that the improvement the yields was so noticeable as to warrant e establishing of extensive experiments on is problem.

One of the most important deductions ade from these rotations is that soil fertily, in Eastern Canada, is the main limiting ctor in crop production. Additions of anure or fertilizers must be made to secure eavy yields of crops and the response to ese applications is greatest on root crops, followed in order by hay, corn and cereals. Barley responds to manurial treatment much more than does wheat or oats, this fact explaining why on poor soils oats is superior to barley while the contrary is the case on rich soils.

Leguminous hay crops, such as Red Clover, Alsike and Alfalfa, are very valuable in improving soils low in fertility. On rich soils, however, this influence is not so noticeable. Alfalfa, it may be said, has considerably increased the yield of hay at Ottawa and while its influence on soil fertility cannot as yet be definitely stated in comparison with that of clover, it is believed to be more potent on account of its deeper and more vigorous root system.

In addition to the influence of the rotations upon the fertility of the soil, a good opportunity is offered to clear the lands of weeds which is a difficult if not an impossible task when the same crops are grown continuously on the same land. Moreover, definite rotations can be arranged which will give the desired acreage of the various crops and, at the same time, distribute and economize manual and horse labour.

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hire Horses and Other Stock to be Imported by Dominion Government.

Mr. E. S. Archibald, Director of Dominion xperimental Farms, accompanied by Mr. eo. Rothwell, Dominion Animal Husbandan, has sailed for Great Britain.

The first and most important object of is trip is the selection and bringing to Canla of five Shire horses, two stallions and ree mares, to be donated to the Dominion epartment of Agriculture by the Shire orse Society of Great Britain. These horses ill be selected by officers of this Society nd the Canadian officials at the great Lonon Horse Show to be held in Agricultural all, London, England, the 22nd and 23rd February. It has not yet been decided st where these horses will be located in anada, but they will be handled by the Exerimental Farms Branch of the Department Agriculture, and will probably become e principal part of a large stud of Shires on one of the Western Experimental Stations.

In addition to the horses in question there will be selected and imported by the same officials a number of sheep and swine, and possibly some cattle.

It is proposed to make the various Branch Experimental Farms, as well as the Central Farm, more and more important as breeding centres for horses, cattle, sheep, swine and poultry with a view to supplying breeding stock for the general improvement of the live stock of this country, and the importations referred to will be distributed throughout the system with this end in view. The development of the bacon industry being at the present time one of the most important lines needing attention the importation of pigs will include a considerable number of Yorkshire, Tamworth and Berkshire boars.

Extension Work and Its Value.

BY H. BARTON

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Extension work of the Agricultural College has been explained as embracing those forms of instruction and other methods of disseminating information which are offered by the College to people who are not resident pupils of the institution.

Canada is well supplied with Agricultural Colleges and Agricultural Schools. They all exist for the same fundamental purpose, education,—education for the betterment of the farmer, the advancement of agriculture, and the development of the country. Farming has become complex, its problems are still multiplying, one has to be well informed and possess marked ability to make a success of it, many farmers are struggling as they have seldom struggled, and the country is suffering because of this condition. Yet it is doubtful if any one of these Agricultural institutions is functioning to its full capacity; at any rate not one of them has had to limit its enrolment.

Primarily the Colleges were organized to teach Agriculture. In the early history of all of them, more especially the older ones, it was soon apparent that if they were to interest farmers and farm boys they must explain their function, if not advertise their wares, to the farming people, and so the Agricultural College man made an effort to gain contact with the farmer. The College man soon discovered that agriculture was a big subject and that he had much to learn, for there were many questions he could not answer. He was compelled not only to divide the subject but also to add another branch of activity, investigation. On these three legs the College got to its feet and seemed able to stand. From the very first the agricultural college unlike some others, seemed to require three legs and to-day it would seem that those which have travelled farthest are the ones that have made the fullest use of all their limbs.

Contact with the farmer soon revea that this was a leg on which the Coll must place a lot of weight. Not only it a question of interesting the farmer; this leg the College must justify its existe only by this leg could it make the ful use of its resources and fulfill its purp of farmer betterment, and finally, as the C lege developed it found another function this leg. It found that if the other two w to be kept on the ground, (for at times th was a noticeable tendency for them to le mother earth), they must be tied down this one. If the teaching of Agriculture v to be worth the time and money it cost a if investigation was to get anywhere as service it must have its inspiration from t farm and be in part at least the product farm information. This external relatio ship therefore, was born of necessity. development was a logical function and wh today there are many other organizatio and agencies serving agriculture, the Colle remains the centre of education in a bro sense and what we now call extension wo seems still indispensable in its life a growth. Upon this thesis I shall try to ju tify this paper.

Extension work in its process of develo ment has taken many forms. It began in simple way by visits of College men to far communities where they gave lectures, som times, it would appear, arranged almo promiscuously, but more often through son organization. The Farmers' Institute pr ceded or accompanied many of the colleg and through this channel the colleges r ceived many calls which afforded them a excellent opportunity to meet their clientel The influence of Dr. James Mills, as Pres dent of the O.A.C., and that of other sta members of the same institution through i stitute meetings is well known to some of u and the service rendered in this way is we remembered and appreciated by farmers a over old Ontario.

Successful colleges have not spared printer's ink. The agricultural press, the circular and the bulletin have all been widely used throughout their development.

It was early apparent however, that it would not suffice to take the college piece by piece to the farmer; too many one-sided visits are seldom well received; visiting is a mutual affair; it works both ways; there must be return visits, so the farmer was invited to visit the college; it was important that he be entertained there, so that he might become intimate with his own institution and made to feel he was a part of it. Accordingly farmer excursions and short courses were developed, and for a time were enthusiastically welcomed.

The colleges grew, work in the college and in the country multiplied, teachers had to be added, investigators had to be added, and finally field men had to be added, for while it was realized that contact between the college man and the farmer was as vital as ever, the problems and duties of the college man were becoming heavier, he must have more time for them and any time he could spare for field work must be given special value; his outside time, being limited, must be carefully organized and well directed; on the other hand the opportunity and need for field work had tremendously increased. There seemed only one way to meet the situation,—extension men had to be appointed. Some of these made their headquarters at the college but most of them were located in the country. They were given various official names, but their purpose was the same, they were to be college fieldmen, to serve as an additional connecting link between the college and the farmer.

This type of field work was at once a popular idea but it would cost money. Governments realized that this was a fine avenue through which to aid agriculture and perhaps incidentally get direct credit for doing so; at any rate they supported it and with Government support came Government control and Government direction. As the work of these local field men developed and their activities multiplied they naturally came in contact with other agencies and organizations. Attempts were made from time to time to adjust their status, to organize and re-organize their work and as a result of this process many of them in different parts of Canada can hardly be called College fieldmen.

From the standpoint of the College this has been a regrettable disadvantage because while it has left the College free for teaching and research it has practically robbed it of organized farmer contact and amounted to setting up a separate system of elementary agricultural education. From the standpoint of the fieldman it was a mistake as many of them very soon realized. Their proper work is educational, they are not agricultural fountains, neither should they be administrative servants; their work is or should be progressive; they have a serious responsibility, and the college is their logical headquarters for much of their information and direction. From the standpoint of the farmer it meant a loss in the education service he received because not infrequently these men were obliged to go their own way as best they could.

With the development of this field work but quite independent of it for the most part came the development of many other organized activities on behalf of agriculture, —the Departments of Agriculture, Provincial and Federal, with their experimental farms, their demonstration farms, their administrative, regulatory and promotion work in one form or another until we have a multiplicity of agencies, all doing more or less field work, much of it educational, some of it research, in places overlapping and with insufficient definition of relationship.

There is considerable co-operation in the various efforts and from time to time attempts have been made to adjust and coordinate the machinery at work but so far no well known clearly defined policy embracing all the agencies for the country as a whole has developed.

Practically all the colleges are doing some extension work; some have extension departments and one through its extension department administers the agricultural societies of its province, using them as an avenue of contact with the farmers. In some colleges no special extension men are employed, the

regular staff doing what they can intermittently, others while separated from the extension organization work in some association with it while in still others the field service seems almost divorced from the college.

In 1913 the Dominion Government passed the Agricultural Instruction Act which provided ten million dollars for expenditure by the provinces on Agricultural instruction, demonstrations, etc., during the ten years ending March 31st, 1923. This gave agricutural education a great impetus but the spending of the money took many forms. One of the chief objects of the Act was said to be the development of extension work but it specified no machinery.

In 1914, just one year later, the United States Government passed the Co-operative Extension Act whereby the Federal Treasury supplied $10,000.00 to each state and an increasing amount each year until 1922 when and after which time the total annual amount for the country would be $4,580,000.00, the state to supply approximately the same amount, all of which was to be devoted to extension work. Unlike the Canadian provision however, it very definitely stipulated how the money was to be used and specified a basis for organization that aimed to insure not only co-operation but also mutual understanding and agreement in the work undertaken. The extension men in the United States number into the thousands but through this Act their field is clearly outlined and their duties are defined.

The Secretary of the U. S. Department of Agriculture in his report for the year 1915 in his reference to this Act stated, "The Co-operative Extension Act of May 8th, 1914, provides for a nation-wide system of instruction for the farming population in Agriculture and home economics outside of the schools and colleges. It establishes a close co-partnership between the Federal and State agencies in the organization and administration of the extension service. The department is under obligation not only to contribute to the formulation of plans of work which are eventually to be agreed upon, but also to assist the colleges in executing them in the most efficient manner. The law contemplates a unified extension organization in each State which will represent and be responsible to both the college and the department."

Canadian conditions are not exactly similar to those of the United States; we have some co-ordination but we also have uncalled for competition. It would appear therefore that our extension programmes, methods, and forces would bear some unification and that our agricultural colleges could with advantage to the colleges and to the whole service the farmer may receive, constitute an integral part of the system.

Our Agricultural colleges as they are at present constituted may be regarded as hybrid institutions,—they are technical colleges in one sense and universities in another, usually with the university character dominant. This dominance in some of them seems to be progressive and in time may result in the segregation of the university character. Is an agricultural university by itself a possible and desirable thing, are the technical college and the university in the same institution handicapping one another, or are they mutually helpful and how shoud they be related? These are questions demanding careful study and collective consideration. Until they are satisfactorily answered, settled policies will not prevail. Meanwhile so long as colleges operate as at present the value of extension work in some form to each institution as a whole is at least twofold. It has proven the most effective means of interesting prospective students in the type of work they are doing. In this regard it may be pointed out that the constituency of the agricultural college is strikingly different to that of most other colleges that usually constitute a university. The educational route in the one case is well organized throughout the country with signposts all along the way whereas in the case of the other in many parts the trail is not even blazed. At the end of the one the objective is a profession well known and highly respected, at the end of the other a profession for some, not so well known and not so fully appreciated, but for the majority, if a college as now operated serves its full purpose, something less tangible and not regarded as a required qualification for earning a living. The agricultural college therefore has this

handicap to overcome in competing for attendance. Publicity has its value in this connection but it is more likely to interest the boy who is not from the farm than it is the farm boy. Most farmers are "from Missouri," they are not responsive to long distance calls. They do most of their business personally as is well illustrated by the army of agents who canvass them, consequently the personal contact with the farmer is what counts.

If an agricultural college is to hold and increase its interest for the farmer and farm boys who contemplate becoming farmers, it must become a factor in shaping policies for farm betterment, and it must give value for the time and money spent by the boy. It must pay the boy to have a college education, not for the sake of education, since he might get that elsewhere, but in what it will enable him to do in farm practice. Sound policies, strong farm courses and effective farm teaching cannot be developed in arm chairs or even in college libraries. They must be worked out in large part in the farm fields, the farm orchards, the farm stables, the farm markets, and the farm homes. The problems of these are not fixed, they are changing and moving and because a college man at one time came from the farm is no argument that he knows the relationship of farm practice to his work and whether he appreciates it or not the farmer and the farm boy always do, and so at present for the college and college man extension work in some form would seem vital.

Agricultural colleges on their present basis can afford little research for the sake of research. As someone has said the problems selected should be not so much those worth while as those most worth while. All research results do not emanate from the laboratory; many of them come to light on the farm, and on most projects in agriculture, if not all of them, a field experience can be brought to bear. There are many distinguished research men in agriculture who have demonstrated the value of wide experience but among them I shall cite only one who may be taken as a classic example. The Experiment Station record in reporting the memorial exercises for the late Dr. Cyril G. Hopkins held at the University of Illinois stated in reference to his work that, "His outlook was toward practice. He never lost sight of those he was ultimately working for, and he interpreted his work and that of others in the light of its practical application, subjecting it to severe test and displaying in this the courage of his personal convictions.

"The exercises were not merely the formal act of the university and his co-workers, but they were held before an audience composed quite largely of farmers representative of the class of practical men for whom Dr. Hopkins has especially labored. Many of them knew him personally and had profited by his counsel, while all knew of his work and the things he stood for."

What shall we say of the value of extension work to the farmer? One sometimes hears the remark, "farmers know how to farm, why all this nonsense?" True some farmers do know how to farm and are able to demonstrate the fact; they are masters of the profession; but their number is not large, the percentage is small even in the best districts.

A Dominion survey made in the Province of Quebec for the year 1919 revealed that in one of the best counties among those surveyed the average labor income was $500.00 while the five best farmers in the same district had a labor income of $2,396.00.

Survey work in Ontario showed that in one of the best counties in the province the average labor income was about $1,000.00 while 20% of the farmers were making over $2,000.00.

The same type of work in the United States established the fact that among any hundred farmers taken as they come, eighteen to twenty would be found making incomes of about $1,000.00 per year more than the average of the community.

Farming however is not a fixed process, it is one of constant change and adjustment. New problems are always arising, which are often difficult to solve, and the best farmer has neither the time nor the means for their solution. The best farmers of some years ago are not necessarily the best farmers of today but the best farmers are the men who will usually seek and obtain the outside in-

formation required. For them extension work is not so valuable but they are among the first to welcome it and make use of anything it may offer.

There is another class of farmers, whose percentage fortunately is small. They are farmers who seem to exist for farming. They would appear to be subnormal and little served by extension work or information in any other form.

The great middle class, probably constituting seventy-five percent, is the class to whom extension work can give most service. These men are not great readers, they do not travel much, they must learn while they work, many of them need suggestion, some of them need encouragement, which can only be given by personal contact. Technical information for the solution of many of the problems peculiar to this class is known; the matter of their betterment becomes a question of applying the information available. This is what extension work strives to do and it is the best known agent for the purpose.

With a view to determining the extent to which extension agencies were functioning in the United States an investigation was conducted in 1919. Four agents travelling by automobile or motor cycle made a house to house canvass of farmers on both sides of the road in four separate regions. In all, 2301 farmers in 143 counties were interviewed and answers to a number of questions were obtained from them. In reference to the value of extension work 58% of those interviewed were favorable, 10% were unfavorable and 32% were non-committal. In some districts, particularly the central States, the work was not so fully established. Among those who knew the county agent and therefore were best able to judge the work 97% in the Eastern States, 72% in the Central States and 95% in the western States were favorable. Of those who attended extension schools 76% stated they had been helped, of those who had been visited by specialists 78% stated they had been helped. A summary of the report states, "that the survey would seem to indicate that extension work in agriculture is pretty well known among the farmers and quite generally approved."

It is to be hoped that a similar survey in Canada would reveal as favorable an a titude.

The value of such work will depend upo how it is organized, what it tries to do, th methods employed and those who undertak it.

The organization behind the field man ha been discussed. In the field it is obviou that in the district allotted to any one man even the local man can give little attentio to each and every individual. He is a bus man and must meet the people and wor with them largely in groups; consequentl he should enlist all the agencies and me who can assist in the service. Some loca organizations will be available, co-operatio with them may be desirable but for mor complete machinery it has been suggested b those who have studied the matter extensive ly that the district should be divided int small communities and each one organize on some simple plan. It probably is tru that in many districts some communities ar overworked while others are not reached a all. The line of most result may be justifie but not always the line of least resistance.

What to do is a separate subject on the programme of this meeting. I should like to put it in the same category as research "not those things worth while, but the things most worth while" and add the opinion that concentration is vital. This opinion is ventured because of the impression that field men, faced with a variety of demands, or being puzzled to know what to do, are apt to spread themselves too much, thereby dissipating their energies and failing to accomplish anything tangible. Usually it is easier to be a mixed farmer than a specialist and perhaps it is safer, but the specialist has a better opportunity of doing some things well. In these days it is not only a question of production alone. Economic production which is even more difficult and more vital, the intricate problems of marketing, the community and the home are all pressing for serious consideration. Projects and programmes therefore should be carefully considered, not by the fieldman alone, nor by any other single party, but by the fieldmen in counsel with the administrative authorities, the educational authorities and representative local men.

Under our conditions there are at least four methods that deserve special mention. They may be called demonstration or illustration, the lecture, the short course and the conference.

The first is sound in conception, based on the principle that for many people the eye is the shortest road to the brain. It would seem attractive for many and impressive for some but limited in its scope. According to the States Relations Service of the U. S. Department of Agriculture it was found after studying this method at intervals of two years for a period of six years that the results of such demonstrations rarely extend beyond a radius of three miles or a circle with a diameter of six miles. The number of people influenced by a demonstration within this section ranged from one to three in such subjects as farm management, variety tests, etc., and five to twenty in simpler things like seed treatment, fertilizers, etc. This was not taken to mean that demonstrations were a mistake but that they must be organized accordingly; they must be simple and numerous, widely distributed and placed in charge of those who are likely to extend their influence.

The special lecture, whether it be at short course, calf fair or ordinary meeting should be intended to serve some specific purpose and it should be properly fitted as a part of the general programme, not only at that particular time but for the season; even this type of work should be progressive in some measure at least. Haphazard, promiscuous lectures may be necessary at times as fillers but they should not be regarded as a regular activity.

The extension short course whether stationary or movable is becoming important. It is an educational course that should be carefully planned, well organized and well taught. Attractions for boys and girls can well be made a feature of it. If it is to retain interest it must provide at least some progressive instruction. Good facilities are imperative and if not movable it should be permanently established where simple but adequate and comfortable provision can be made. Stock judging for instance cannot be done satisfactorily in a stable or in a cold improvised shelter. The need for good accommodation is being appreciated and has already been met in some places. In Nova Scotia, community accommodation for such purposes, according to Principal Cumming of Truro, has been a telling factor in the continued success of the short course and the real service it is able to render.

The conference is a method that should be developed. There are examples of good farm practice or some part of it in every district. There are men in every district with good experience, opinions and ideas and there are annual problems such as seed, feed and fertilizers common to the community. Why should not local questions be mutually analysed in the light of local information in the smaller meetings at any rate? They may take the form of a paper or discussion by one or two, followed by general discussion. It may not be vigorous at first but it will develop and with it will develop the thought of the farmer. A little social side may be added if necessary. At the larger meetings they may take the form of debate, motor excursion, farm visits, etc. If the fieldman has something to report, suggestion to make or advice to give this would be a good place to present it.

Individuality counts in most things; there is no activity in which it counts for more than in extension work. Among the qualities that must be conspicuous may be mentioned energy and activity—the extension worker must be a worker; enthusiasm, he must be a dynamo of enthusiasm, it is infectious; conservative judgment, anything irrational will shake the confidence and lose the respect of the farmer; sympathy with prevailing conditions, revolutions are seldom possible; keenness for new information—the field for study is as great in extension work as it is in post graduate work; a man among farmers—the farmer is a shrewd judge of men and he demands the best.

Extension work was born of necessity; it is still developing and the need seems greater than ever, but work that served the past will not do so well for the future. The superficial, the perfunctory, the haphazard or the scattered effort may have been excusable in the past and may have served some purpose but the future demands the deliberately planned, the thoroughly organized, and the intensively operated.

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Extension Work and Quebec Farmer Needs.

R. R. NESS

Burnside Stock Farm, Howick, P. Q.

If we may be guided by the general discussion, among farmers, of their needs, they may be considered to be many and varied. I believe, however, that most of our needs could be remedied materially by education. Agricultural Colleges, throughout the Dominion are doing their best to provide that education in many different ways.

In the first place, we need to be educated to help ourselves, to have a higher respect for our calling, and to assist in raising the standard of that calling in the eyes of the general public. We must be educated to put into practice the methods recommended by Colleges and Experiment Stations; these methods are, in most cases, the result of many years of experimental work. In that way we can make better and more proper use of our naturally rich and fertile soil, and make more profitable and attractive farms.

Conditions in many respects have changed materially in the past few years, but farm methods and practices have not kept pace with these changes. For instance, in the best dairy sections of Quebec, there are good farms which are being operated under practically the same methods as were practiced by the last generation, and producing about the same amount of dairy products as were produced years ago. These practices are giving these farmers a scant living on farms that could and should be returning a fair profit.

These conditions are mainly responsible for the fact that so many of our boys are leaving the farm, a deplorable condition which is being given much publicity at the present time. Boys are likely to stay on the farm if the farm is profitable and attractive and if they are given some interest in it. Even if the boy is given a college training to prepare him for the high standard of our calling, the condition just mentioned will still apply.

I know that our fine system of Experimental Farms and our Agricultural Colleges are doing excellent work in solving problems, and distributing the results to us, but we are slow in taking advantage of the information that is so freely offered. I feel that our educational institutions, working together, should find some way of giving practical instruction on our farms, which would help to gain the confidence of apparently wary farmers. If farmers will not come to the colleges for instruction, it must be taken to the farmers. This would also help to interest the boys in the courses which are being offered but which are too poorly attended. We, in our turn, should form committees in different districts, with the object of inducing our boys to take advantage of the excellent instruction being given at these institutions.

We need to be instructed in the study of our soils and their requirements. We are playing with our farms. It is not more acres we need; we need to practice more scientific and intense cultivation.

We should not be too deeply concerned about the price we get for our products, although that is of importance; we should give some study to the application of principles which will help to lessen the cost of producing these products.

We need practical education along agricultural lines, if the fundamental industry of our country is to prosper. Let me give one instance of the practical instruction given by an extension official. In our parish, which is a small one, this extension worker advocated clover seed growing. He did not give this instruction by distributing bulletins, but by actual practical demonstration. In a few years the parish sold $55,000 worth of clover seed in one year. Today clover is one of our standard crops, and has developed to such an extent that two large hullers have been steadily employed for four months and there is still some threshing to do.

There is a great field for extension work in the study of our soils and their requirements, in the use of proper fertilizers to strengthen to some extent our depleted soils, in the growing of crops which will increase the returns from our live stock, in many phases of our live stock industry, particularly breeding and feeding. And last, but not least, we need to change the system of teaching in our rural elementary schools, so that the instruction given will be more along agricultural lines.

Farmers' Organizations.

L. C. McOUAT

Live Stock Branch, Department of Agriculture, Ottawa.

This subject is such a broad one and has so many phases that it is impossible to cover the ground in the amount of time which we are willing to give it. Consequently I am going to limit myself solely to outlining some of the fundamentals underlying farmers' organizations, and try to suggest a basis for a closer co-ordination between the profession as an organized body, and the various Agricultural Associations throughout Canada. That, after all, is one of the objects of this Society and one which I feel is not being fulfilled to its fullest extent.

We must remember that farmers are individualists. The very nature of their business has developed isolation and individualistic tendencies among the farmers. They look upon their problems as their own and as they go about their work their minds are occupied with these. Until recent years the abundance of seasonable labor precluded the necessity of co-operation in the performance of any particular piece of work. All this has tended to establish the industry of farming on an individualistic basis. In many sections the isolation of the farm family has been increased by the differences in nationality, religion, and social standards among the people comprising the community.

These conditions have acted as barriers to the development of social units and when the time has come that farmers could co-operate to economic advantage, the same conditions which contributed to their isolation are acting as barriers to the development of co-operative effort.

Why Farmers Organize

In more recent years our farming has been undergoing a change. Generally speaking it is becoming more complicated, and its successful prosecution is proceeding along business-like lines. This calls for a broader knowledge of production and business organization and develops a greater desire and need for co-operation both in the production and marketing of farm products. This is evidenced by the increasing number of co-operative organizations such as wool growers, co-operative creameries, cheese factories, live stock shipping associations, poultry associations, fruit growers and numerous other organizations for the development of greater efficiency in production and marketing.

These organizations have been born of necessity. Because he felt that an an individual he was being exploited by other interests the farmers took a leaf from the experience of big business. He has come to the point where he is determined that his own exploitation must cease. He is not entering the business world for the purpose of exploitation on his own score. He is not of that temperament; he is entering the business world for the express purpose of saving himself from the economic ruin that has so nearly engulfed him.

The present progress merely indicates the length to which he may go. But as to whether farmers can ever get together and succeed in big business is no longer a subject of debate. They have and are succeeding beyond their wildest dreams.

Co-operatives are bound to fail; many have been started in localities where the enthusiasm and the co-operative spirit of the co-operators have entirely led them astray. Their possibilities of sufficient volume to make the venture a success are too meagre to grant success. Others have unwisely chosen incompetent and poorly trained managers; still others lack adequate facilities to insure financial success. But this is no brief against the soundness of the whole movement. Private individuals are failing in business every day, yet none arises to charge that business itself is to blame.

This growth has not come by chance. It has come through the most painstaking and heart-breaking work that has ever confronted

man in the economic world. It has taken long years of preparation through educational work to bring about this development. Other organizations have contributed their large part in laying the foundation stone for this big economic movement. Instance the simplest of all, the Farmers' Clubs. These have been instrumental in developing the elementary principles of co-operation and are, in numerous instances, preparing the way for co-operative production and marketing by bringing the people together and creating a greater unity in spirit and in thought. Breed Associations and Clubs, Seed Growers' Associations, Horticultural Societies and in fact Agricultural Societies of all kinds have contributed in some measure towards paving the way for this last and soundest of all farmer movements, namely the economic organization of farmers into commodity groups, thereby giving them the opportunity to dispose of their products in a well regulated, orderly, economical manner.

It is the only salvation of agriculture, and there is no future in store for the farmer so long as he is at the mercy of the other interests. It should be kept in mind that the farmer is the only business man who works entirely in the dark. He produces without markets; he does not know, when he plants his crops, what price they will bring or whether they will bring anything at all. He has nothing to say about the value of his products when he brings them to market, nothing to do with price fixing. He plants his crops, determines the acreage, hires his labor, incurs debts in harvesting—all in the dark.

On the other hand, when he comes into the market as a purchaser of supplies, he must pay the price which others have set. It is not a favorable price such as others have secured on his products, without reference to the cost of production. The advantages which the business men secure through their organization, he is unable to secure. He must ever gamble on winning even his expenses, let alone a profit.

The farmers co-operative movement is here to stay. The work of local development is still going on. The farmer has found the tool with which to combat the economic conditions which have threatened to ruin him; he is now setting up the machinery necessary to win this economic freedom. And he is building in all directions and building as strong as he knows how.

Our Responsibility to Farmers' Organizations

I have pointed out that all types of organizations have helped out, in this movement and instanced the farmers' clubs, because these are probably the most numerous and simplest of them all and a type which we all come in contact with in some capacity. In an educational way the farmers' club can be a clearing house of ideas and, from the standpoint of the farm family, it is the most effective place in which to discuss the solution of problems confronting the individual and the community.

The rural problem as it exists to-day may be divided into six general parts as follows:

1. The application of modern conveniences in the home;
2. The development of farm finance ;
3. The development of the community into a more complete social unit;
4. Better organization of the farm business for more efficient and economical production;
5. The development of co-operation in the production of standardized products and their marketing to the best advantage;
6. The development of efficient systems of rural school education.

No one is more conscious of some of these problems than the farmers themselves, and they should receive the most authorative information relative to their solution, where solutions or methods of dealing with these problems have been worked out. This is one point of contact between professional workers in agriculture and the farmer. Are we making the best possible use of it?

In the first place are these Clubs sufficiently alive and active? I fear that in too many instances they are not. Too often the members, or a small portion of them, have met, passed the time of day with their fellow workers and probably listened to a talk on some agricultural subject, (sometimes good and sometimes poor); then they adjourn to their homes, still wondering why they are

not as successful farmers as they feel they ought to be. Although primarily the responsibility for an active organization rests with the members, I am firmly convinced that in most cases this will not work out unless the Club has leadership. In many cases this means our field workers or extension men. They must and should accept this responsibility and foster these organizations in every possible way. This can only be brought about by having a definite program and by having the members take part in it. By a program I mean something that will lead to some definite and tangible result, not simply a list of meetings with a program of speakers, etc., for each—that in itself is not sufficient. The Club should be doing something which will tend to improve the farmers' position in that community, and in most instances this comes down to placing him in a position to do business on a more satisfactory basis. For example some of our most successful Clubs have contributed the following towards the development of co-operative organization—one Club developed a potato producers' association, one a live stock breeders' association, one a co-operative insurance company, one a beef ring, three developed co-operative telephone companies, four developed farm labor associations, sixteen formed live stock shipping associations.

This means vision, getting the members together and talking the thing over,—studying the problems. If a boost is needed the outside speaker should be primed as to the objective and his talk should be along suitable lines, preferably a forceful presentation of the business value of the project to the farmers. As soon as the time comes when Club members are ready to co-operate in making the use of associations for the marketing of farm products or for the purchase of supplies, such organizations should be created for the handling of such business activities. To illustrate: let it be assumed that the members of the Cookshire Farmers' Club find it would be to their advantage to ship their live stock co-operatively instead of handling the business through their club organization; they form a live stock shipping association entirely separate from the Farmers' Club, with its own officers and constitution and by-laws.

Research workers must also participate in this program. Granting the value of research along lines which may eventually give us information of value, we must at the same time have a goodly proportion of such efforts directed along such lines as will afford immediate relief to economic problems. Our field men and extension workers need this help and are entitled to it. For example, one source of relief to the farmer to-day must be found in his costs of production. On the whole these are larger than they should be in view of the advance in science and in the methods our best farmers are practicing. Industry can prosper even when prices are falling, providing costs can be reduced. The best example of this is the automobile industry which is prosperous although selling cars at less than pre-war prices. It would indeed be folly to base any agricultural program upon an assumption of rising prices. These are now higher than during the five year period preceding the war, and it is unlikely that they will remain so; consequently our profits must be increased through reduction of costs. Our investigators must appreciate this and endeavor to help in this problem.

The knowledge of the scientist and the practice of our best farmers are being incorporated in the industry too slowly. For this condition, I believe we have ourselves to blame. In the past we have used almost exclusively the methods of education, in which the distribution of printed bulletins played a considerable part. These reach only a few and as a rule do not "put across" the ideas which they contain.

In order to make more rapid headway the various forces operating must be brought closer together. Investigators must keep in closer touch with field workers in order that their work be applied in such a way that the farmer can readily appreciate its usefulness. In other words the community must be made aware of the opportunities which await the individual who will adjust his production to reduce wastefulness and cost. To accomplish this we must work through groups of farmers organized along the lines of their common interest.

De la Nature de l'Acidité des Sols.

H. M. NAGANT,

Professeur a l'Institute Agricole d'Oka.

L'emploi des matières calcaires sous forme de chaux vive, de marne et de pierre calcaire pulvérisée, pour l'amendement des sols de la province de Québec est à l'ordre du jour.

Cette question concerne, évidemment, en premier lieu l'agriculture, mais, comme tous les problêms agricoles d'ailleurs, par répercussion elle intéresse encore bien d'autres industries ou professions; et, en l'espèce, les exploitants de carrières à pierre calcaire, les fabricants de concasseurs et de pulvérisateurs, l'industrie des transports, etc. Nous en avons d'ailleurs immédiatement la preuve par la publicité faite en faveur de l'emploi des amendements calcaires par des personnes intéressées dans les industries susmentionnées.

Aussi nous estimons qu'il peut-être d'intéret général de faire une courte étude de la cause ou plutôt d' une des causes nécessitant la mise en oeuvre des amendments calcaires. Pour l'agronome, en effet, les fonctions remplies par la chaux dans la fertilisation des terres sont relativement nombreuses, mais, dans la conception populaire, le but principal, si pas unique, du chaulage est a destruction ou neutralisation de l'acidité du sol. Tout le monde qui est un peu en relations avec les choses de la terre, sait fort bien que l'état d'un sol que l'on désigne par "*condition acide*" est un état préjudiciable à la bonne végétation et au rendement satisfaisant des récoltes.

Aussi, parmi les causes que militent en faveur de la consommation des amendements calcaires, nous ne voulons considérer, au cours de cet entretien, que le phénomène de l'acidité.

Qu'est-ce que l'acidité du sol?

Ceux qui n'ont pas le loisir de s'occuper de technologie du sol, ou de pédologie, s'imaginent volontiers que la réponse à la question est fort simple pour un expert en la matière et que l'allignement de quelques formules d'acides suffira pour expliquer l chose à tout homme possédant des notions d chimie élémentaire.

Il n'en est rien cependant et, comm preuve de la complexité du problème d l'acidité du sol, citons immédiatement ce lignes que nous empruntons à un des plu récents manuels américains sur l'étude d sol, intitulé: "*The nature and properties o soils*", par T. L. Lyon et Harry O. Buckman professeurs en technologie des sols à l'uni versité Cornell, état de New York.

"La nature exacte de l'acidité du sol es si peu comprise, qu'il est impossible de l définir ou de l'expliquer à moins que ce n soit dans des termes tout à fait généraux. Au point de vue pratique ce que l'on appell acidité du sol peut être considéré comme un état plus ou moins défavorable à la croissance des plantes, résultant du manque de certaines bases actives dans de sol et qui en pratique est supprimé par l'addition de chaux sous différentes formes."

Conception aucienne concernant l'acidité du sol

Autrefois, c'est-à-dire jusqu'au début du siècle actuel, l'idée règnait généralement dans les milieux agricoles que la condition acide était un phénomène commun seulement aux terres riches en humus et plus particulièrement aux terrains bas et tourbeux, où la matière organique se décompose à l'abri de l'oxygène libre de l'air, dans un sol gorgé d'eau.

Déjà au début de la deuxième moitié du siècle dernier, un savant allemand du nom de Mulder s'était livrè à des travaux de recherches considérables pour essayer d'établir la composition chimique de la matière humique. En traitant de l'humus de teinte brunâtre, laquelle teinte, comme on le sait, est généralement un indice de sa nature acide, il en avait séparé un corps, correspondant suivant lui à la formule moléculaire $C_{40}H_{14}O_{12}$, auquel il donna le nom ***d'acide***

humique ou *d'acide ulmique.* En outre de celui-ci, il fait encore mention de l'*acide crenique* $C_{24}H_{24}O_{16} + H_2O$ et *apocrénique* $C_{24}H_{12} + H_2O$ déjà décrits, par le célèbre chimiste français Berzélius, comme un acide soluble dans l'eau dérivant de l'humus (*T. J. Mulder- Die organischen Bestandteile im Boden Chemie der Ackerkrume. Berlin* 1863).

D'autres chimistes tels que Detmer, Thénard et Stockbridge, firent des travaux sur les mêmes substances et établirent également des formules moléculaires approximatives, différant plus ou moins de celles de Mulder et Berzélius, pour les acides humique ou ulmique, crénique et apocrénique (*Herbert Ingle-Manual of Agricultural Chemistry, page* 54 - 1908).

Les combinaisons que l'acide humique ou ulmique étaient supposés former avec des bases telles que la chaux, la magnésie, la potasse et l'ammoniaque reçurent le nom d'humates ou d'ulmates, de crénates et d'apocrénates. L'étude de ces sels semblait démontrer que ceux à base de potasse, de soude et d'ammoniaque étaient solubles dans l'eau, tandis que ceux à base de chaux, de magnésie, de manganèse et d'aluminium étaient insolubles.

Travaux plus récents concernant les composés humiques

Depuis longtemps les chimistes considéraient comme peu probable l'existence comme tels des différents composés acides de l'humus, décrits par Mulder et étudiés par d'autres experts; ils soupçonnaient qu'ils ne représentaient en realité que des mélanges plus ou moins complexes de plusieurs substances, plutôt que des corps d'une composition bien définie. Mais l'avancement insuffisant des méthodes de la chimie organique furent longtemps un obstacle à une étude plus approfondie et plus scientifique des corps formant le mélange complexe et continuellement sujet à transformations, que représente l'humus dans les diverses conditions où on le trouve.

Il y a une douzaine d'années, Oswald Shreiner et un groupe de collaborateurs du "*Bureau of Soils*" des Etats-Unis appliquèrent des méthodes plus modernes à la détermination minutieuse de la nature des constituants de l'humus. Leur investigations ne portèrent pas sur la nature organique d'un sol déterminé mais sur celle de sols variés prélevés à différents endroits. Aussi les experts du *Bureau of Soils*" en arrivèrent-ils à isoler de la matière humique un grand nombre de composés organiques plus ou moins complexes décrits dans différents bulletins publiés par eux.(*O. Schreiner and E. C. Shorey -.The isolation of harmful organic substances from soils,.-.Bulletin* 53, - 1909); *et autres bulletins.*

Des expériences montrèrent que beaucoup de ces composés présentaient des propriétés toxiques pour les plantes, lorsque introduits dans des solutions nutritives; ce fut en se basant sur ces observations que Milton Whitney échafauda en grande partie sa fameuse théorie sur les toxines du sol qui donna lieu à tant de discussions parmis les spécialistes en matière d'étude des sols, aussi bien en Amérique qu'en Europe.

Or, dans la longue liste de corps organiques identifiés par les savants américains, nous trouvons, outre les composés ordinaires provenant de la désagrégation des matières protéiques, treize acides organiques tels que l'acide monohydroxystéarique $C_{18}H_3O_3$ dihydroxystéarique $C_{18}H_{36}O_4$ oralique, succinique, acrylique, nucléique, saccharique, etc.

Cependant l'identification de ces différents acides n'a pas de quoi être considérée comme la révélation d'une chose surprenante ou inattendue; plusieurs de ces corps préexistent déjà tels quels dans les organismes végétaux vivants, d'autres représentent les produits naturels de la décomposition et fermentation de matiéres protéiques, de corps gras, et de certains hydrates de carbone, formant les organismes végétaux et animaux. Il semble donc assez logique qu'on les retrouve dans le sol, à l'une ou l'autre des différentes phases qui marquent la marche de la décomposition des matières végétales ou animales; mais on peut présumer aussi que dans un sol aéré, à fortes propriétés oxydantes, la plupart de ces corps organiques toxiques à la végétation, qu'ils soient des acides ou non, n'ont qu'une existence transitoire et éphémère, de sorte qu'ils disparaissent rapidement à la suite des phénomènes d'hydrolyse et d'oxydation en-

trainant la minéralisation ou érémacausis de l'humus.

Il n'en est pas de même cependant pour l'humus tourbeux formé à l'abris de l'air, dans des conditions anaérobiques, chez qui le caractère antiseptique de certains composés formés devient un obstacle au développement des bactéries oxydantes, même après l'égouttement éventuel du terrain et l'aération qui s'en suit.

Les colloides comme cause d'acidité du sol

Un fait constaté depuis quinze ou vingt ans c'est que la condition d'un sol qu'on est convenu de désigner sous le nom d'acidité est un phénomène beaucoup plus général qu'on ne se l'imaginait autrefois. L'observation a démontré en effet qu'elle ne s'étend pas seulement aux terres fortement chargées de matières organiques et mal égouttées, mais, on peut dire, à la majorité des sols cultivés dans les régions à climat humide, de l'Amérique, c'est-à-dire de l'est des Etats-Unis et du Canada. Cette constatation attira surtout l'attention lorsque Wheeler et Hartwell de la Station Expérimentale du Rhode Island eurent démontré les conditions presque universellement acides des terres anciennement cultivées de cet état. Or, parmi ces sols plus ou moins appauvris par les récoltes sans restitution adéquate, il en est qui sont précisement presque entièrement épuisés en humus ou matière organique.

Nous savons aussi que tous les sols contiennent des matières colloïdales en proportions variables: "Au cours des vingt dernières années, une telle importance a été accordée aux colloïdes du sol, que certains auteurs affirment actuellement qu'un sol sans colloïdes n'est pas un sol du tout, au moins au sens agricole du terme qui signifie un milieu dans lequel les récoltes peuvent se développer et trouver leur nourriture" (*Sour Soils and Liming, by Dr. William Frear, p.* 75). Parmis ces colloïdes il en est d'organiques c'est-à-dire formés de composés humiques, mais aussi des minéraux. Ces derniers sont surtout représentés par des silicates d'alumine hydratés, du sesquioxyde de fer hydraté et de la silice, à l'éat colloïdaux. Ainsi les terres fortes, argileuses, remferment une proportion particulièrement élevée de colloïdes minéraux, principalement sous forme de silicates hydratés dérivant du kaolin.

Or, entre autres propriétés des colloïdes on a observé leur tendance à absorber plus ou moins avidement les bases ou ions métalliques des sels, qui se trouvent à l'état de dissociation partielle dans la solution du sol, jusqu'à ce qu'ils soient saturés. En l'occurence l'acide du sel reste non combiné en l'absence d'nne autre base, telle que la chaux, pour le neutraliser. Ceci explique par exemple que l'addition d'une solution neutre de KNO_3 à une terre riche en colloïdes non saturés, communique rapidement une réaction fortement acide vis-à-vis de la teinture de tournesol, à la solution du sol. Les colloïdes ayant absorbés l'ion K+, l'ion NO_3 —a formé avec l'ion H +, provenant de l'eau faiblement ionisée, du HNO_3 qui produit la réaction acide. Le Même phénoméne peut se produire avec les sels d'autres acides, tels que $(NH_4)\ 2\ SO_4$, KCl, etc. Aussi l'on considère que dans beaucoup de sols, la présence de silicates colloïdaux relativement dépourvus de bases devient une cause, au moins indirecte, d'acidité, par suite de leur pouvoir d'enlever les bases des solutions neutres de sels, tels que le nitrate de potassium, l'acétate de sodium, le chlorure de sodium, etc.

(*Harris Technical Bulletin, No.* 19 *Michigan Agr. Coll. Experim. Station*).

Ceci expliquerait donc le caractère acide de bien des terres glaiseuses, dépourvues cependant de matière organique.

Acidité due à la présence de composés toxiques d'aluminium, de manganèse ou de fer.

Récemment plusieurs savants américains, tels que Abbott, Conner et Smalley montrèrent que l'infertilité de certains sols réputés acides due à la présence de sels d'aluminium, toxiques pour les végétaux (*Bulletin No.* 170 *Station Exp. de Purdue*). En 1918 Hartwell et Pember démontrèrent d'une manière positive que dans certains sols acides l'ion Al + est bien plutôt le facteur nocif que l'ion *H* l'accompagnant.

De même l'action délétère sur les plantes des composés ferreux qui apparaissent dans les sols dits acides, est connue depuis longtemps.

Enfin les sels de manganèse, plus solubles dans les terrains à réaction acide semblent encore très toxiques aussitôt qu'ils atteignent une certaine concentration.

L'addition de chaux ou de magnésie à ces sols aurait pour effet d'insolubiliser les composés d'aluminium, les sels ferreux et les sels de manganèse et de les rendre ainsi inoffensifs.

Nutrition insuffisante des plantes.

Lyon et Buckman ("The nature and properties of soils" 1922) mentionnent encore comme un aspect du phénomène d'acidité, le manque de calcium en tant que principe nutritif direct des plantes ou encore à titre d'élément synergistique, c'est-à-dire d'agent facilitant la pénétration d'autres ions nutritifs dans la plante. L'expérience démontre, que certaines plantes, telles que la luzerne par exemple, ont besoin de beaucoup plus de calcium et autres bases, pour effectuer leur processus métabolique, lorsqu'elles croissent en terrain dit acide. D'autre part les auteurs rapportent que R. H. True (*The Function of Calcium in the Nutrition of Seedlings; Journal of American Soc. Agron., Vol.* 13, 1921) a montré que la présence de calcium en quantités considérables est nécessaire lorsque certaines plantes poussent dans une solution nutritive, afin que d'autres principes nutritifs puissent pénétrer dans ses cellules. Ainsi par exemple on aurait trouvé que le potassium n'était que faiblement absorbé, même lorsqu'il était présent en quantités considérables, tant qu'une certaine concentration d'ions calcium n'était pas atteinte; c'est cette fonction du calcium qui est désignée sous le nom de synergisme par les auteurs.

Résumé.

En résumé (suivant Lyon et Buckman), au point de vue technique, on peut donc attribuer à trois raisons principales, ou présenter sous trois aspects, les effets nocifs de l'acidité du sol:

1o) Une concentration anormale des ions hydrogène pouvant résulter:

a) De la présence d'acides organiques ou minéraux solubles dans la solution du sol.

b) De l'existence d'acides insolubles ou de sels acides qui par réaction avec de l'eau peuvent produire l'acidité.

c) A l'absorption sélective des radicaux basiques par le sol (les colloïdes du sol), en suite de laquelle l'acidité peut provenir de la présence de sels neutres ou même alcalins.

2o) La présence de composés solubles toxiques d'aluminium, de manganèse ou de fer, présence ordinairement concomitante d'une concentration anormale d'ions hydrogène, ou acidité proprement dite.

3o) Enfin une nutrition défectueuse de la plante résultant du manque de calcium en tant qu'élément nutritif direct ou agent synergistique.

Enfin, de quelque manière que se manifeste la condition acide, on peut dire que celle-ci est essentiellement caractéristique des régions à climat dit "humide" c'est-a-dire celles où une proportion notable de la hauteur annuelle de précipitation atmosphérique s'infiltre dans le sous-sol.

L'action constante des eaux d'infiltration est de dissoudre et d'entrainer les radicaux basiques (CaO, MgO, Na_2O, K_2O), des minéraux constitutifs du sol, en proportions beaucoup plus grandes que les radicaux acides (SiO_2) ou indifférents (Al_2O_3—Fe_2O_3); dans ces conditions il a fatalement tendance vers l' acidité.

Pour se faire une idée de l'importance de cet appauvrissement continuel du sol en radicaux basiques il suffira de savoir que, d'après Lyon et Buckman, pendant une période de dix années on a enrégistré aux lysimètres de la station experimentale de l'Université Cornell une déperdition de 3702 lbs. de CaO, 1741 lbs. de K_2O et 942 lbs. de MgO, à l'acre.

Real Profits in Limestone.

Contributed by the Department of Colonization and Development, C.P.R., Montreal.

Professor W. S. Blair, of the Government Experimental Station at Kentville, Nova Scotia, is authority for the statement that all soils will benefit from the use of limestone and that fifty per cent. of Canadian soils would be more highly productive if lime were used upon them. He pointed out that the idea that lime is valuable only as a corrector of soil acid is incorrect as it enters into the formation of plant food compounds without which plants cannot do their best. Lime furnishes a base essential for the development of food combinations suitable for plants, and corrects soil acidity which is objectionable to certain plant growth.

The professor speaks not from baseless theory but his observations are the definite conclusions resulting from a series of exhaustive tests carried out on the farm at Kentville. These tests were thorough in every respect and extended to a variety of crops. To make his results as comprehensive as possible, and drive home to farmers the tangible, material benefits of limestone in the soil, he states his profits in cold dollars and cents. The basis of valuation are conservative prices prevailing during the periods of the test, 80c per bushel being allowed for potatoes; 90c per bushel for oats; $12.00 per ton for hay; $6.00 per ton for straw; and $2.00 per bushel for wheat.

The tests cover two periods of three years each, 1914 to 1916, and 1917 to 1919, each inclusive. In 1914 four series of plots were laid out and commercial fertilizers applied to each in equal amounts except on one section of each series, which was left without fertilizer. Two series were limed at the rate of 2 tons per acre and two left without lime. These plots were not fertilized or limed again until 1917. Potatoes, oats and hay were harvested in 1914, 1915, and 1916. In 1917 the whole area was fertilized with 15 tons of stable manure per acre and the ground was again limed at the rate of 2 tons per acre, and also fertilized. In six years there was used on the best fertilized plots 1,100 pounds of commercial fertilizer, 15 tons of stable manure, and 4 tons of lim stone per acre. Similar plots had manu with and without fertilizer, and with a without lime.

The summary of results is as follow Taking first the plots fertilized and manure In the first 3-year period the plots limed a fertilized produced $118.55 as against $98. on that merely fertilized, a gain of $20.4 In the second three year period when ma ure was added that with lime produc $360.62 and that unlimed $312.03, a ga for the former of $48.59. The total ga in six years time from the use of lime w $69; the cost of the lime and its applicatio $16.80; and the profit per acre above t cost of lime $52.20.

To take next the crop not fertilized b manured in 1917. In the first period the pl limed produced $94.15 and that unlime $80.16, a gain for the lime treated land $13.99. In the second period after ma ure was added the land with the lime in produced $339.72, and the unlimed pl $260.58, a gain for the former of $79.1 The gain from use of lime in the six yea period was $93.13; cost of lime and appl cation, $16.80; profit per acre above co of lime $76.33.

Taking the value of the crop per acre f the six years the gain from lime in the fir case was $69 and in the second $93.13. I the comparative tests to determine the valu of fertilizer on limed land the gain fro fertilizer was only $27.90 in contrast, whic subtracting the cost of the fertilizer, left profit per acre of $17.40.

More briefly summed up, the first thre years the lime added was worth $10.20 pe ton from increased yield where fertilize was used, and during the second thre years $24.29 per ton from increased yiel where fertilizer and manure were used. Lim added to the unfertilized area was wort $6.99 per ton from increased yield durin the first three years, and on the unfertilize area, manured, $39.57 per ton. For th whole six year period the fertilized an

manured area returned an increase from lime equal to $17.25 per ton for each ton used, and the area not fertilized but manured, an increase from lime equal to $19.08 for each ton used.

These are real profits, eloquent figures of money, which Canadian farmers can secure for themselves by the greater use of limestone on their lands. On a farm of large or small acreage increased profits of such magnitude are not to be neglected. Every section of the Dominion, particularly the eastern provinces, has its limestone deposits, developed or undeveloped, and the ton of limestone produced there for less than two dollars is worth multiples of this on the land.

Concerning the C.S.T.A.

NOMINATIONS FOR DOMINION OFFICERS.

Nominations for President, two Vice-presidents and an Honorary Secretary-Treasurer of the C.S.T.A. must reach the General Secretary not later than March 31st. Such nominations must be endorsed by at least ten members in good standing. Notice to this effect has been sent to each local secretary, and it is expected that every branch will send in nominations. The election ballots will be mailed to all members on April 10th and the resuts of the elections will be announced in the May issue of *Scientific Agriculture.*

C. S. T. A. BOOKLET.

On February 24th a special C.S.TA. Booklet was mailed to all members. This booklet contained a complete list of members with their addresses. If any member failed to receive the booklet, or if any address in the list of members as published is incorrect, the General Secretary would appreciate advice to that effect. The list of members will be revised in June next and embodied in the Convention programme.

The C.S.T.A. Booklet is being used in connection with a Dominion-wide membership campaign among agricultural graduates, and others eligible for membership. The last page of the booklet is a membership application form, and members can assist materially in the campaign by urging all eligible members with whom they come in contact to sign this application and forward it to the nearest local secretary or the General Secretary.

SCHOLARSHIP FUND.

The attention of members is directed to the full page announcement, in this issue, of the establishment of a Graduate Scholarship Fund by the Society for the encouragement of specialist training in agriculture by our members. It is important that donations to this Fund should be made as soon as possible for disposal during 1923. Members of the Board of Trustees will endeavor to secure grants from private individuals and corporations and it is expected that a certain amount of money will be set aside from the advertising revenue of *Scientific Agriculture.*

With over six hundred members in the Society it was presumed, when this Fund was established, that it would be supported by the members themselves within the limits of their financial circumstances. Money received in this way will be assigned to scholarships endowed by the members, and a generous response is expected.

All donations to the Scholarship Fund from members of the Society should be sent to the General Secretary for deposit.

For further particulars see pages 29-31 of the C.S.T.A. booklet.

BUREAU OF RECORDS.

An effort is being made to give greater publicity to the Bureau of Records which has been established in the office of the General Secretary. During the month of March it is intended to solicit the complete co-operation of all agencies employing agricultural graduates. Members who have not received the questionnaire that is being used in con-

nection with the Bureau should apply for it at once, and members who have returned the questionnaire should notify the General Secretary of any changes or additions that should be made in their records. By means of the campaign in March it is hoped that the Bureau of Records will become more active and be of greater service to members and employing institutions than formerly.

CONVENTION NOTES.

The third annual Convention will be held at the University of Saskatchewan, Saskatoon, June 20th to 23rd, 1923.

Delegates and members will be accommodated in the University residences at nominal rates.

An Entertainment Fund will be provided by the Saskatchewan Department of Agriculture.

Any members wishing to present any resolution to the Convention, or to suggest any amendment to the Constitution or By-laws of the Society, should submit same in writing to the General Secretary before April 30th.

The arrangement of the Convention programme is now being undertaken and the final programme, when completed, will be published in *Scientific Agricuture*. This will probably be in the June issue, which will be mailed to all members on May 31st.

NOTES.

J. F. Booth (Sask. '19) is taking graduate work in Economics at Cornell University, leading up to the degree of Ph. D.

S. G. Lochhead, Professor of Bacteriology at the University of Alberta, has been appointed Dominion Bacteriologist, and will assume his new duties at Ottawa in the near future. Dr. Lochhead graduated in Science (M. Sc.) from McGill University and in 1914 obtained his Ph. D. degree at Leipsic University. At the outbreak of war he was interned and remained a civil prisoner in a detention camp for four years. He returned to Canada in 1919, for some months occupied a position in the Bacteriological Department of Macdonald College, and was appointed to the staff of the University of Alberta about one year ago.

Dr. Lochhead is a son of William Lochhead, Professor of Entomology and Zoology at Macdonald College.

APPLICATIONS FOR MEMBERSHIP

Gilbert Arnold (McGill, 1918, B.S.A Grenville, P. Q.

S. F. Boily, (McGill, 1922, B.S.A.) Sh brooke, P. Q.

E E. Brockelbank, (Saskatchewan, 19 B.S.A.) Saskatoon, Sask.

N. Curtis, (Toronto, 1920, B.S.A.) E monton, Alta.

W. J. Elliott, (Toronto, 1898, B.S.A.) C gary, Alta.

J. R. Fryer, (Toronto, 1913, B.A., M. A Edmonton, Alta.

D. M. Laurie, (McGill, 1921, B.S.A.) He mingford, P. Q.

M. D. MacCharles, (Toronto, 1920, B..S.A Lennoxville, P. Q.

R. A. McLoughry, (Ont. Vet. Coll., 189 V.S.) Winnipeg, Man.

J. P. Sackville, (Toronto, 1915, B.S.A Edmonton, Alta.

H. B. Sommerfeld (Saskatchewan, 192 B.S.A., Wisconsin, 1922, M.S.) Winnipe Man.

G. M. Stewart, Calgary, Alberta.

G. V. Vantaulk, (Iowa, 1905, Leipsic, 190 B.S., M.A.) Edmonton, Alta.

The present list of members, as publishe in the C.S.T.A. booklet, contains 640 name and is the largest list in the history of t Society.

LOCAL BRANCH MEETINGS.

Annual meetings of the Nova Scotia an New Brunswick branches have recently bee held and new officers elected. The results o these elections are shown on the page givin the organization of all branches.

Important meetings have also been hel at Edmonton, Winnipeg, Macdonald Colleg and Charlottetown during the past month.

Both the branches in Ontario are arrangin to hold meetings in March, and it is probabl that a number of other branches will co duct their annual elections during that mont

EDITORIAL

AGRICULTURAL RESEARCH.

A gratifying appreciation of the importance of research is becoming noticeable among institutions which are connected with the advancement of agriculture. The complexity of many of the problems which confront the agricultural industry has demanded that those who are engaged upon a study of these problems must have a thorough training in the fundamentals of research and the technique of research. Hence we find that an increasing number of our professional workers in Canadian agriculture are taking specialist training, or post graduate training.

Our Canadian agricultural colleges are meeting the situation by providing, in several instances, advanced courses in one or more lines of agricultural science, and by encouraging members of their teaching staffs to improve their own training in order that they may give a more finished course of lectures to those who study under them.

There are certain phases of the question of research training that are not receiving as much consideration as might be expected. It is not appreciated, for instance, that there are scores of men qualified and anxious to obtain specialist training who are unable to meet the cost of such a training. Most of those who have taken advanced academic degrees have done so either at the expense of great personal sacrifice or by making satisfactory arrangements, as to leave of absence, with the institution employing them. This is a condition that is manifestly unfair.

If Canada requires specialists who are qualified to carry out research work of national economic value, it is obviously the duty of the Canadian public to produce such specialists. The relationship existing between agricultural prosperity and national prosperity is not hard to understand, and the relationship between research and agricultural prosperity should be just as apparent. The logical conclusion, therefore, is that public encouragement must be given to agricultural research if our basic industry is to prosper.

Another question that must be taken into consideration is that of salaries. What financial reward is received by the average research worker? What encouragement is offered to the man who enters the field of research? These questions are not often asked by the typical research worker, who seldom thinks about his salary, but employing institutions should not take advantage of the unselfishness of this class.

The whole question of research is now receiving a great deal of consideration, because we are in a period when specialists are essential to progress. So far as agricultural research is concerned, we must encourage specialist training in every possible way, but we must not overlook, or fail to encourage, the man who is financially handicapped but whose further training would provide a national asset. Above all, let us adequately reward those who are giving good service, and producing valuable results, in the professional fields of agriculture.

FARM SANITATION.

Statistics show that less than five per cent of the rural homes of Ontario are equipped with a modern water supply system. In other provinces conditions are probably no better. The average farmer continues to water his stock by hand; his wife draws water from the well or stream and carries it to the home dozens of times each day for personal and culinary uses; the toilet conveniences of even the most modest urban home are very seldom seen.

This is a condition that must have a direct bearing upon the great national problem of rural depopulation. If we expect the youth of our Canadian farms to remain on the land we must provide them with conditions that are just as attractive as those found in the town or city. If these conditions were equal other influences would not be so noticeable.

No one will deny that the advent of the rural telephone, the automobile and the electric light played a tremendous part in removing the quality of isolation from farm life. The improvement in country roads has also been an important factor. These comforts and conveniences have all been introduced during the past twenty-five years. Neighbors have been brought closer together, towns and cities are within easy reach, marketing facilities are better and many other desirable features have been introduced, directly or indirectly, because of these important industrial developments.

The water supply system, with its accessories, appear to have been overlooked. Those who are accustomed to travelling through farming communities cannot but be impressed with the discomforts and inconveniences suffered by the farmer, and even more pronounced in the case of his wife, through the lack of sanitary toilet and culinary facilities. Nor does there appear to be very much appreciation of the risk of disease from a water supply which, in many cases, must be germ-laden.

Apparently the manufacturers of water supply systems, sewage disposal systems and sanitary fixtures are not alive to these conditions and are making little effort to remedy them. It would appear, too, that the farmer has a mistaken idea as to the cost of equipment and installation. Therefore, two distinct campaigns are necessary—one of an educational nature which will clearly explain to the farmer the waste of effort and the risk to health of his present system of water supply, and the other of direct contact and salesmanship on the part of reliable manufacturers. A double-barreled campaign of this kind would be productive of results which would have an important bearing upon the question of rural depopulation and which at the same time would be profitable to the manufacturer.

AGRICULTURAL POLICIES

In a country as vast as Canada, where agricultural education, extension, investigation, research and administration are so wide in their scope, there is great danger of overlapping and duplication of effort. This danger has been recognized by those who are directing these several branches of agriculture and some effort has been made to formulate policies which will be satisfactory to all the agencies concerned. Much remains to done in the way of co-ordinating effort a it is to be hoped that uniform agricultur policies will soon exist throughout the Do inion. At present there appears to be litt or no understood relationship between t different provinces, or between differe agencies in the same province.

The Federal Department of Agricultu the Provincial Departments of Agricultu and the Agricultural Colleges are all attemp ing to advance the agricultural industry. A three have the same objectives in view an in every province, representatives of all thr are to be found. There must be some w in which these different agencies can get t gether for the purpose of drawing up clear stated national and provincial policies, ar of adhering closely to those policies.

In the early part of 1920 a conference w called by the Federal Minister of Agricu ture, at which the Provincial Deputy Mi isters and the officials of the Dominion D partment of Agriculture were represente This conference was held at Ottawa and las ed for several days. Valuable informatic was obtained, certain conclusions were reac ed, and strong recommendations were mad The agricultural colleges were not represen ed and apparently no attempt has been mac to put into effect, in a general way, the r visions of policy which seemed to dema attention. The consequence is that the co ference of 1920 has not been of permane value, although the motives behind the co ference were highly commendable.

If it were possible to bring together, i conference, representatives of the three age cies mentioned, and out of that conference t appoint provincial committees which woul carry out the recommendations of the confe ence as they affected their particular pr vince, the benefits to the industry would b prodigious, far-reaching and cumulative.

A resolution embodying the foregoing wa recently passed at a meeting of technica agriculturists and representative farme held at Macdonald College. It is to be hope that this resolution will result in a nationa conference being held in the near future, a which the whole question of co-ordinatio and unifying of agricultural policies will b considered, and provision made for puttin into effect the conclusions reached.

Competition*

F. M. CLEMENT,

Dean of the Faculty of Agriculture, University of British Columbia, Vancouver.

Competition assumes the right of freedom action, and freedom of choice of enterise, and freedom of bargaining for every dividual. By such action also we assume at the fittest will survive in business. We so assume because public demand is a sure dication of the business to follow, that we ll render the greatest social service, or rvice to society, by attempting to take adntage of this demand in order to acquire alth for ourselves. My contention to-day, imarily, is that such assumptions may be rrect only when individuals or groups rt equal, are equal, and have equal barining power. Can I, who have 500 or 1,000 xes of apples to sell, bargain with you, a yer, or dealer, on an even basis? Possibly an, but it may be that you may be indifrent about the purchase, while my creditors demanding pay. It may be that you as buyer have a special knowledge of the rket, which I cannot have. It may be at because of years of experience you have better bargaining ability. My contention that only equals in experience, in social tus or economic status are equal bargains, and it is the purpose of my address toy to show one way how that equality ght be attained.

The Mercantile System

From the early part of the sixteenth cenry until late in the eighteenth century the der of the day was control of industry by gulation. It was the period of rapid ange from old agricultural systems to mething of a beginning of what we have day. It was the period of "enclosure" of common fields of England, and the rise the domestic system in industry. England s changing in part from cultivated fields pastures and England was beginning to port woollens instead of wool from her ep industry. The old open field system d memorial system of agriculture were ing way. There was now a free labor class and competition was being brought into play. A vain attempt was made by government regulation to stem this change, and to retain the customs of the Middle Ages. To quote from Colbert of France "The State decided who should be allowed to work, what things they should be permitted to make, what materials should be employed, what processes followed; not the taste of consumers appeared before the French king to ask tended to." Men were not free to do as they pleased industrially. This was a part of mercantilism of the sixteenth, seventeenth and part of the eighteenth century. Mercantilism generally was much more than this, but the point I wish to illustrate is that of the attempted regulation and control of industry.

Laissez Faire

Now let us go to the opposite extreme. The story is told that one time, about the middle of the eighteenth century, a body of petitioners appeared before the French King to ask for relief from this vast body of regulation and restriction. When asked what he, the king, should do to relieve the situation the petitioners are said to have replied "laissez faire, laissez passer"; that is, let things alone, or let them take their course. This body of men believed in a natural law that would more or less right the ills of society and business if allowed to do so. (Whether the story is true or not makes but little difference—it is equally illustrative.)

This was the beginning of the era of free competition, the rise of capitalism and the labor organizations. The belief at first was that the only function of government was to protect life, liberty and property. The individual knew his interests best and would act accordingly. The basis of the whole economic system may truly have been said to lie in self interest. It was the period of the rise of industry and the universal free play of competition came to be the prevailing ideal. It was out of this spirit that England became a free trade nation, the last step in the removal of trade regulation being taken with the repeal of the corn laws in 1846,

* An Address delivered before the B. C. uit Growers' Convention, January, 1923.

the Act going into force in 1849. The reaction against absolute freedom of action in trade and business had, however, set in even before the last Act of the old system had been repealed. It was found that goods were sometimes adulterated in such a way that the buying or consuming public could not detect it; and consequently government regulation was necessary. It was found that some may attempt to defraud if not under government regulation; but the greatest evil of absolutely free competition came in the employment of labor, the use of women and children in the factories and the mines and the long hours of labor that seemed to be sapping the very life of the people. These people could not bargain equally. It was first a struggle for a twelve hour day for the children, and no work for children at night. It was not until 1819 that an Act was passed forbidding the use of children under nine years of age in the cotton mills, or forbidding the working of children under sixteen more than twelve hours a day. You know a great deal of the struggles of labor; but it was claimed by employers that the labor of children was necessary, and the long hours were necessary in order to meet the competition. This *was* the competitive system. But out of it we have legislation dealing with "employers' liability," "Workmens' compensation" and the general regulation of industry, and I might add business and business corporations also.

Some of you will remember the words of Thomas Hood in that poem memorized by many students "The Song of the Shirt," two lines of which are:

"O God! that bread should be so dear,
And flesh and blood so cheap!"

"When we still hear the principle of 'a fair field and no favor', and 'no State intervention' advocated by a man strong in the consciousness of personal advantages, we must remember that he is a century behind his time, and that he has not read or has not profited by one of the most dolorous chapters in human history." And the English nation to-day is returning to the principle of the regulation of industry in the interests of her people as a whole, and this regulation has tended to personal development, and has contributed much towards the common good. We have a great example to-day in our railway commissions; not our railway commission is all that we like it to be at times, but without it we be open to a vast exploitation by the portation companies. The struggle for way commissions is an interesting chap economic history. The sort of regul however, which gives us liberty and is structive, is that well illustrated by the of the Russian cabman in Petrograd wh mediately following the Revolution, in in driving on the side of the street a the general traffic instead of with it. had a new found freedom, and wish exercise it, even though it was to the mon danger. Traffic regulation is a structive force for the common good.

But well might you ask "What has a this to do with agriculture?" "Very li you might say, "except that we have pa cases of regulation in the Weed Act; the by-laws, and more particularly the Hor tural Regulations with respect to insect and particularly codling moth." No is permitted knowingly to contaminate community with the pest. The Fruit M Act is another example. This is the cons tive regulation of industry. Absolutely competition has given way to the cons tive social control of industry in the int of the community. How much longer public opinion permit any individual b efficient bargaining to lower the standar his community ?

Labor Organizations are as Trade Lines

Labor organizations are not on ge lines. We have iron workers, railroad w ers, cotton workers, carpenters and n others each with a separate union. Al nearly all are federated under the grea ternational Federation of Labor, but they organized along trade lines. Farmer ganizations along general lines have so not been a success, as exemplified by Grange, the Union, the Alliance and Equity. To-day organization is on com ity lines; fruit men, grain men, stock poultry men and others are in separate ganizations. It is necessary to do so order to bargain successfully. Only eq have equal bargaining powers, and it is by organization that this power is attai

te also that we have great combinations capital also in our great business organizans. The man of small capital cannot ually compete successfully with the corration of large capital. The millions in corporation are made up of small ounts from stock sold here and there, or m large amounts borrowed from the banks, banks having obtained it in small ounts from the people. Labor and capital both in some form of combination. Lar is organized in order to increase its barning effectiveness or in order to be on re equal ground for bargaining purposes h large combinations of capital. Farmers ve been the last to organize for bargaining rposes.

Agricultural Implements

It is interesting to note that in 1869 there re approximately two thousand industrial nts' producing agricultural implements in United States and Canada. By 1900 the mber had been reduced to six hundred and ty. In many instances companies had en eliminated by competition, but in many re they had been absorbed by larger corrations. In 1890 a very determined attempt s made by the five leading companies to algamate into one concern. This, howr, was not accomplished until after twelve rs of bitter competition. In 1902 these npanies amalgamated, and by so doing control of the manufacture of approxately ninety per cent. of the grain binders. ey immediately organized a distributing l merchandising system in such a way that re was little or no duplication of effort. e combination gave them control of eighty cent. of the mowers also.

The growth of the company, now known The International Harvester Company, is ognized as having been relatively conserive. When certain lines of manufacture re more or less perfected, they spread out the manufacture of wagons, manure eaders, gas engines, tractors, cream separrs and other implements. In order to ilitate the purchase of iron and steel they ned control of ore lands in Wisconsin, coal lands in Kentucky, and established a st furnace and steel plant in Chicago. ey also purchased timber limits in Miso ri and Mississippi. One of their adventures has been the establishment of a twine factory in Minnesota. It is worthy of note also, that, generally speaking, with the exception of a few years during the war the price of farm implements to the farmer has fallen more or less steadily. In other words, the purchaser of farm implements, except in a few cases, has not suffered so much by the price that he paid for the implement due to combination as he has from overpurchase and misuse of those implements. This does not mean that the price of agricultural implements is not still relatively high, but that the price is lower than it would likely have been under a system of extremely free competition.

Price

Price is made in the open markets under competitive conditions. The supply and marketing conditions in Wenatchee, Hood River, Yakima, and other places have much to do in determining it. The fruit crops in Ontario and the Maritimes, and also New York State are big factors. There is always, or nearly always, a surplus in America. There has always been a surplus in British Columbia. Under such conditions what happens when several hundred or a thousand growers all start to bargain in one market? One may offer No. 1 of a certain variety of apples at $2.00 per box, another the same grade and quality at $1.90, and another the same at $1.80, and some may even take a chance by consigning to an unknown market at an unknown price. Which man sets the price for the day or the week or even for the season? Is it the man who offers at the higher price? Not at all. Just so long as the quantity can be purchased at the lower price, the price will not advance. Or in other words, the men with the lowest price, the men with the lowest efficiency, the men who are most easily frightened, or the men who must sell in order to get something out of their crops are the men who fix the price for the time being. This is marketing on the most inefficient basis. It is inefficient for the producer; it is inefficient for the distributor and does not assure the consumer a steady supply. As Dr. Macklin illustrates the principle: It does not assure the consumer one apple, or two apples, or more when he wants them. It is not merchandis-

ing. As opposed to this we have the suggested organization with bargaining efficiency; one man with full knowledge of the markets acting for a large group instead of a small group. The work is to be done by experts. This is efficiency as opposed to inefficiency.

The Marketing Margin

Under our system of distribution certain marketing services must be performed. Or to use the words of the economist, "An article is not produced until it reaches the consumer." Consequently there must be a difference between the amount paid by the consumer and the amount that the farmer receives. This is the marketing margin. Just how wide this margin should be is difficult to say. Under a system of private enterprise where the individuals are operating for private gain, the cost of performing each of the marketing services must be sufficiently wide to permit the most inefficient man who stays in the business to exist. This might be illustrated by the fruit packing house charges so familiar to all. Let us say, for example, that it costs 60c a box to grade, wrap, pack and load apples into the car, this charge paying for wrapping paper, boxes and other materials, and also the general overhead of the packing house. The packing house with the smallest amount of business and most inefficient management will likely not be able to do business for less than the 60c. On the other hand, a more efficient manager with a larger volume may be able to operate his packing house at a cost of 55c; while some other man may be able to operate at a cost of 50c per box, and the most efficient man with a large volume may be able to operate at a cost of 45c per box. The last three men make a profit of 5c, 10c and 15c per box, respectively. The marketing margin must be sufficiently wide in each case to permit the most inefficient men in the business to live. Any system that reduces this marketing margin to the lowest possible point must either give the consumer cheaper products or give the farmer more money for the articles that he has produced. Or, as is actually the case, both changes are likely to be noticed. The farmer wants a narrower marketing margin, and consequently greater consumption. The private middleman lives on the wider margin. This would therefore lead us to believe that there is a conflict between co-operative keting and private business in-so-far a marketing services are concerned. Bu the end private business stands to gain m ially because of the increased purcha power of the consuming public.

Some Examples of Past Efforts

The present relation of the farmer t marketing system has been reached onl the process of evolution. Various ef have been made to obtain the desired re The American Society of Equity at its in tion sought to control markets and price withholding produce, particularly w from the market until such time as the agreed on among themselves—the growe was reached. Such a programme mus course invariably fail since the price wheat is based on the total supply in world rather than the amount flowin market from any particular community

The Farmers' Union of the Sout 1905 and 1906 tried to limit productio planting 26,000,000 instead of about 000,000 acres of cotton. A circular was out asking farmers to plow up 10 per of their acreage. The members were a ed to grow more diversified crops in p of the cotton, but in the words of their le "Whenever we tell the farmers to plant cotton they plant more." The reason this is obvious. *It is a question of inte competition in a co-operative organizati*

In the case of tobacco an attempt made to force up the price by the destruc of a part of the crop. All of you k something of the night riders of Kentu and the methods they used. The immed effect was to force up price due to shor of supply, but the effect of the campaign the next year was to encourage produc elsewhere, and the tobacco area spread Missouri and Texas. Rising prices due shortage, magnified the supply and the q tion of the quantity of production immed ly got out of hand.

The Non-Partisan League of more re years tried another method. Their effo still being watched with a great deal of terest. Their plan was to have public ow ship of the market facilities, elevators, pack houses, storage plants, flour mills, and o facilities in connection with marketing. H

successful their effort will finally be is not readily to be guessed. It is expected that something is to be gained even though the League is now on the down grade, due to the rise of a newer organization.

The Federated Farm Bureaus of the United States organized in 1920 are on sound economic lines. They are organizing on commodity lines for marketing purposes. They had their struggle between a minority group that had the idea of price control by selling only when the price was right, and a majority group that was anxious to sell to the best advantage in view of the price-making forces at work in the open markets. It was a struggle between a price-fixing group, the price to be based on cost of production and the group that recognizes that the prices of agricultural products are determined in world markets, and that it should be the aim of the farmers' organization, by the use of the most efficient means, to obtain for its members as large a share as possible of this price.

The principle as illustrated from the organization of the Federated Farm Bureaus is the one on which all farmers' co-operative organizations are operating to-day. British Columbia has a large surplus of fruit products, and so long as we have this suplus it will be necessary to compete in foreign markets where world prices prevail. The problem for the individual fruit grower is to get his cost of production within the sale price determined in the open markets. If he receives a high price over a period of years, production increases very rapidly. If he receives a low price, even for one year, the orchards are invariably neglected. A reasonable price not fluctuating to too great a degree from year to year will tend to a steady rather than a spasmodic growth of the industry. If the price becomes unreasonably high there is immediately a very marked improvement in methods of culture and possibly in the extension of the orchards also. No matter how well organized the growers might be, it is impossible to check or control this internal competition. Every man in the organization retains his individuality, and will produce more or less according to the amount of money he receives for his labor. The co-operative organization differs from the business corporation in that it is impossible to control supply. The efficiency due to competition is retained. At the same time the growers enjoy the privileges rising out of large scale production, equal bargaining power, and the advantages of experts employed to perform the marketing services for them.

Summary

The fruit grower cannot control absolutely the rains and the snows that may modify his water supply. He cannot always make provision against frosts, winds and hail that may at times cause injury; nor can he always remain free from insects and diseases except at the price of constant vigilance. Science will help him very much in the judicious distribution of his water supply, and in warnings with regard to frost and storms. His cultural methods may be almost ideal. The Horticultural Regulations will encourage in the control of pests and diseases, but at times he will still be at the mercy of the elements. There will be continual fluctuation in the quantity produced from year to year. What is produced must be marketed. The growers' marketing organization, unlike an industrial organization, is told each year that there is a certain quantity to market. The grower says, "I have produced so much of a certain quality, you must sell it for me." The sales organization does not say there is a market at a certain price for certain goods, and ask you to produce exactly this, or more, and no less. The year's production must be marketed regardless of the quality and the quantity. This can be accomplished most satisfactorily only by building up a merchandising system that will distribute widely and give the consumer exactly what he wants at the time he wants it. Economically, the growers must render efficient service to the thousands of consumers. By doing so they will promote their own selfish interests and the selfish interest of the community as a whole.

I look forward to the time when public opinion will be so strong in favor of co-operative action that a single individual will not be permitted to act alone, to quote a price, or to dump or slaughter low-grade products in such a way that he may jeopardize the welfare of the community of which he is a member. His own interests are the community interests. This is the guiding principle. Co-operative action alone will save the situation. It is competitive and efficient and improves the bargaining opportunity. Only equals can bargain equally.

On Soil Fertility

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"The most important material problem of an agricultural country is to maintain the fertility of the soil." On the productivity of land depends the production of food and on the supply of food depends the development of a people. In new countries where agriculture is young and flourishing the people are apt to forget that their prosperity, unless provision is soon made for the return to the land of the fertility removed by crops, is the first step toward land ruin. Plants are not made out of nothing. The soil is a medium for plant growth and furnishes to the plant a part of the necessary plant food materials from which the plant builds itself. It is not enough merely that the plant food materials be present in a soil; they must be present in forms which can be dissolved in water for it is only in water that plant food materials can be carried or taken inside the plant. This fact explains why virgin and new lands are so productive. Nature through her chemical and physical processes going on continuously for ages in the soil has accumulated a store of these soluble or readily available materials. As long as these supplies remain sufficient to satisfy the crop needs productive yields may be secured.

The results of continuous cropping of land to one crop is seen in the decreased yield of wheat at Rothamsted, England, the oldest Agricultural Experiment Station in the world. At Rothamsted wheat grown every year on land since the year 1844 without soil treatment of any kind has decreased from 17.4 bushels per acre, the average for the first eight year period 1844- 1851, to 10.4 for the eight year period 1900-1907. The longer land is cropped the greater is the depletion of nature's supply of available materials and the more wasteful are the methods of farming the faster is the rate of depletion.

When it is remembered that nature's processes are very slow and that it takes but the short period of about a generation of farming to bring about decreased yields virgin lands, the importance of followi practices which lead to soil improveme and not to soil depletion is not hard to s Successful agriculture is to farm the la without abusing it, to work it with a pro and yet leave it to succeeding generatio with its productive power unimpaired.

The agriculture of the ancients was pur ly an art and remained so until the develo ment of natural science and its applicati to agriculture. The beneficial effects of a plying manure or decaying organic matt to the soil was known to the Romans in t time B. C. The value of legumes, crop r tations and applications of lime and fertili ers to soils for increasing crop yields w known long before scientific study ma clear the reasons for those beneficial effect It is through systematic and exact methods investigation that an insight is obtained in the work of nature and it is this knowled of the why and how of nature's process that constitutes the domain of science. Scien then means knowledge: "To plow the lan and plant the seed and cultivate the crop art, or practice. To know what the soil an air contain and what the crop requires science."

In the study of soil fertility we mu make great use of that part of science calle chemistry which deals with the compositio of matter and the changes in compositio which matter undergoes. Matter is made u or composed of about eighty simple sub stances called elements, which may exis separately or in combinations called com pounds. An element is a substance whic cannot be divided or broken up into two o more different substances. Examples of el ments are iron, sulphur, oxygen of the ai and carbon. While about eighty element are known, only about forty are more or les common, and only about fifteen which occu

n the air, soil, plants, and animals are of pecial interest to agriculture.

Plants require for their normal growth nd development but ten of these elements. These elements are as follows:— (1) Carbon, (2) Hydrogen, (3) Oxygen, (4) Nitrogen, (5) Potassium, (6) Phosphorus, (7) Sulphur, (8) Calcium, (9) Magnesium and (10) Iron. They are called "essential elements" of plant foods, for each has a specific function in he growth of the plant and one cannot take he place of another. If even one is lacking, or present in too small amounts in proporion to the others, plant growth will be impaired or not take place at all. The elements carbon, hydrogen and oxygen are obtained by the plant from the air and water and make up about 95 per cent. by weight of the common mature crops. The other seven elements are obtained from the soil. Carbon in the form of carbon dioxide and a part of he oxygen, both of which are unlimited in supply, enter the plant through the leaves in he form of gases. Oxygen gas also enters the plant through the roots. The other elements in suitable compounds in solution with water are taken into the plant through the small root hairs. Water is a compound of hydrogen and oxygen and not only does it serve to supply these elements but it is the means by which raw plant food materials can enter the plant and be conducted to he laboratories of the leaves where the products with which a plant builds itself are made. This double role of water makes it of utmost importance.

The elements phosphorus and nitrogen are often deficient in soils and their supply in he soil as compared to the amounts required by crops is not large. The elements potassium, sulphur, calcium, iron and magnesium are contained in most normal soils in sufficient amounts compared to crop requirements, that their supply rarely becomes depleted. While potassium is required by plants in large amounts it is fortunately also present in soils in large amounts. It is for he most part locked up in insoluble compounds and if the rate at which the potassium is made soluble is too slow to satisfy the needs of the growing crop this deficiency will prevent a normal yield. However it is in he phosphorus and nitrogen that a soil is likely to become deficient first and it is the problem of keeping the soil supplied with these elements that has been of greatest concern in maintaining its productive power.

There are six positive essential factors in crop production,—moisture, heat, light, good seed, proper seed bed and food for the plant. It is the factor of food for plants which is most neglected yet, with the exception of good seed bed, the factor which the farmer can most easily and largely control. In the following table are figures which show the average amounts in pounds of nitrogen, phosphorus and potassium in wheat, alfalfa and clover hay, and potato crops per acre.

TABLE 1.

		N.	P.	K.
Wheat—Grain	35 bus.	50 lbs.	8.4 lbs.	9.1 lbs.
Straw	1¾ tons	17 lbs.	2.5 lbs.	31.5 lbs.
	Total	67 lbs.	11 lbs.	40.6 lbs.
Alfalfa Hay	2½ tons	125 lbs.	11 lbs.	60 lbs.
Clover Hay	2 tons	80 lbs.	10 lbs.	60 lbs.
Potatoes	300 bus.	63 lbs.	13 lbs.	90 lbs.

In the system where wheat is grown continuously both phosphorus and nitrogen are removed from the soil in the grain which is sold, for about three-fourths of each of these elements in the crop is in the grain. Now if the straw of this crop is sold or burned, which is a practice on many of the farms of the Canadian West, the remaining one-fourth of the nitrogen is lost to the air. The phosphorus and potassium in the burned straw are returned to the soil in the ash. It is to be noted that but a little less than one quarter of the total potassium of the crop is in the grain and that about three-quarters is found in the mature straw. As long therefore as the straw is returned to the land in the form of manure, the loss of potassium is comparatively small. In burning straw not only is about one quarter of the total nitrogen of the crop wasted, but organic matter is destroyed. Organic matter incorporated into a soil will not only furnish the succeeding crops, in its process of decay, with most of its own nitrogen and phosphorus, but will also improve the physical conditions of many soils. Organic matter in light sandy soils will increase their water-holding capacity, will lessen or prevent drifting and in the heavier silt and clay soils will make them more open and easier to work.

The loss of organic matter from the soil is going on continuously through processes of decay and oxidation which processes must necessarily take place in profitable farming. The better the soil is aerated the faster is its rate of destruction, for it is an abundant supply of oxygen of the air, together with bacteria in the soil, which brings about such rapid decomposition. One can understand now how the practice of summer fallow for conserving moisture makes plant food available. It is through the gradual decomposition of organic matter that its nitrogen, phosphorus and other elements are made over into forms in which the plant can use them.

The process by which the nitrogen change is made is called "nitrification" and involves three distinct steps, each brought about by a specific kind of bacteria. Nitrification can go on normally only in soils well aerated and supplied with lime. The nitrogen after nitrification is in the form of nitrate which is very soluble in water. It is therefore easily leached from the surface soil to the deeper layers and may be lost through drainage if heavy rains occur, before it can be used by growing crops. This explains how the black fallowing is a wasteful practice, for here conditions are ideal for the formation of nitrates, yet no crop is growing to utilise them. Fortunately the element phosphorus, which is changed to the phosphate form, is not so readily lost through drainage waters.

It is entirely possible to grow wheat continuously on the same land but it has never been found to be good practice or profitable. To return to the records of the Rothamsted Station we have for a period of 55 years a comparison of the average yields of wheat on land receiving (1) no treatment (2) 15.7 tons manure per acre and (3) commercial mineral fertilizers.

TABLE 2.

Average yield of wheat for the period of 55 yrs. 1851-1906

No treatment	12.9 bus. per acre
Manure 15.7 tons annually per acre	35.5 bus. per acre
Mineral fertilizers	37.1 bus. per acre

From these figures it is shown that the fertility of a soil can be maintained by the application of large amounts of manure and commercial fertilizers, but such practices have never proven economical for general farm crops. It should be noted however th organic matter in the soil as a source plant food is not absolutely necessary growing crops, for in Table 2 the supply the essential elements in the soil has be maintained by applying them in mine form.

The practice of conserving, as far as p sible, the organic matter already in the s and adding to it plant residues and fa manures that are available, supplemented phosphatic mineral fertilizers if necessa has proven the most successful by far.

The return to the land of only the pla residues and manures made from the *cere* crops grown upon it will not indefinite maintain the soil's supply of nitrogen a phosphorus, if either the grain or anim fed upon this feed are sold from the far If, however, sufficient feed from other far is bought and fed and this manure in ad tion is returned to the land, the supply these elements is maintained. But this is poor system of agriculture, for a part of t land is made productive by depleting t fertility from another part. It is necessa therefore to include in a system of permane agriculture practices which will enrich a land if real soil improvement is to be mad

The cheapest method of adding nitrog to the soil is by growing legumes, as alfal and clovers. Nitrogen composes about percent of the air and while its supply inexhaustible it is only the legume crop through certain kinds of bacteria living the nodules on their roots, which can u the nitrogen directly from this source. Table 1 the figures for the nitrogen conte of 2½ tons of alfalfa hay (average yield p acre) is 125 lbs., and of 2 tons of clover h is 80 lbs. At least 60 percent or general about two thirds of the total nitrogen co tent of these crops, both hay and roots, com directly from the air and about one third the total nitrogen content of the plant r mains in the roots in the soil.

From these facts then the total nitrogen the hay is gain, for while the legume plan secure one third of their required nitrog from the soil, they also leave one third their nitrogen content in the soil in the roots. If now such crops are returned the soil as crop residues and farm yard ma ures there is added to the soil, from 2½ to alfalfa hay, an amount of nitrogen abo

equal to that which is removed in the grain of 2½ crops of wheat of 35 bushels, and from two tons clover hay an amount of nitrogen about equal to that in the grain of 1½ crops of wheat of the same yield.

It should be noted that in both 2½ tons alfalfa hay and two tons clover hay there are 60 lbs. of potassium which through the decay of this organic matter would become available for succeeding crops, but if the hay is sold from the farm this potassium as well as the phosphorus is lost.

Phophorus is lost from land mainly through products sold. It should therefore be returned in some cheap commercial form, especially when applied to large acreages.

A fact which should be remembered is that the nitrogen, phosphorus and potassium content of fresh farm yard manure is in general three quarters of that of the feed and bedding of animals in livestock production. The remaining quarter is required for the growth and development of the animal and the production of animal products, as milk and wool. The value of manure therefore depends to no small degree upon the age and kind of animals.

It is impossible to exhaust or deplete a soil entirely of the essential elements of plant growth. It is easily possibly, however, to deplete a soil to the point where the growing of crops is unprofitable. A normal productive soil which can be taken as a standard will contain, on the average, in the plowed surface of an acre 7 inches deep, 2,000 lbs. of phosphorus, 8,000 lbs. of nitrogen and 35,000 lbs. of potassium. These amounts are exceedingly large compared to the amounts needed by a single crop, but when it is considered that only a small part of these amounts is made available to growing crops each season, the importance of keeping in the soil a large supply is at once recognized. It has been roughly estimated that during an average season and for the average crop, but 1 percent of the total phosphorus, 2 percent of the total nitrogen and ¼ percent of the total potassium is made available to crops. As the total or potential supply of these elements diminishes, then the available supply to crops becomes less.

While the supply of nitrogen, phosphorus and potassium usually requires our attention first, there are other factors which are likewise important for profitable agriculture. A soil must contain limestone which is necessay both for the nitrification process and for the best growth and development of legume crops. Limestone in heavy clay soils also brings about a better physical condition which promotes both aeration and drainage. Crop rotation is profitable practice, for crops differ not only in their plant food requirement but also in the extent of their root systems and their feeding powers or ability to get elements from the soil at a rate which meets plant requirements. Plants high in protein material, as legumes, can make available and use the phosphorus of normal calcium phosphate, (the form normally in the soil) which other plants, as corn and wheat, cannot secure at a sufficiently rapid rate.

The biological conditions of the soil must also not be overlooked. The soil is a living mass of micro-organisms and as the science of soil biology develops, more and more is soil fertility correlated to bacterial activity. Available plant food materials are made through chemical and physical changes, and the organisms in the soil assist in producing many of them. In farm practice it is the business of the farmer to maintain in the soil conditions which favor or promote the desired processes.

On new and virgin lands it is comparatively easy to grow crops, for the farmer is not required to give much thought to his system of farming in order that he may receive profitable returns. It is not until decreased crop yields or economic adversity has begun that thought is given of the morrow. The embryo of a seed furnishes food to a young plant until it establishes itself in the soil. Throughout nature the young are nourished until they can care for themselves. So in the readily available fertility of new land provision has been made for the livelihood of people until they have learned to live economically and to use the land intelligently. Profitable farming has gradually become more difficult and it is now necessary to know and to follow scientific methods for its successful and permanent operation.

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The Relative Value of the Monthly Distributio of Egg Production.

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In respect to the business of egg production, which has received considerable impetus in recent years, the outstanding feature of economic significance has been the prevailing prices obtaining for eggs. The relatively high prices which have prevailed during recent years have made possible the development of commercial poultry plants giving reasonably remunerative labor incomes. There has been much discussion as to the possible profits in egg production and from various sources data have been presented dealing with many important factors involved. In the great majority of cases, however, the factors receiving closest attention have been those including the annual egg production per bird, the amount and cost of feed consumed per bird annually, and the amount and cost of feed to produce one dozen eggs. In none of the literature on the economics of egg production, as far as the writer is aware, has due consideration been given to the phase of the relative value of the rate of production as affected by the price of eggs, which varies from time to time throughout the year. The object of this paper, therefore, is to indicate the significance of the rate of production as affected by the price of eggs. In other words, the data pertaining to groups of birds are analyzed from the standpoint of ascertaining the relative value of the monthly distribution of egg production.

A knowledge of such on the part of the practical poultryman is fundamentally important if the maximum labor income is desired. The outstanding feature in connection with the business of egg production, in Eastern Canada particularly, has been the characteristic high prices prevailing from September to February inclusive each year as compared with lower prices prevailing from March to August inclusive. The custom has been to stress the importance of winter egg production, and it seems probable that sufficient attention has not been given to late summer and fall production. If it can be sh that late summer and fall production is r tively as important as winter production t the possibility of developing early matur laying strains deserves consideration. another paper this matter will be discuss in this paper the relative value of mont distribution of egg production is determi using feed and egg prices as given in tables and in the context.

The writer does not hesitate to emphas the fact that there are many factors invol in the economics of egg production wh are not considered in this paper, as for stance, the cost at the beginning of the y and the selling price at the end of the y of the birds providing the data, the cost housing, and overhead expenses of vari kinds. In a general sense at least, the o cost factor taken into consideration in t paper is the feed cost. Furthermore, writer would urge a particular warn against drawing conclusions concerning c and profits in egg production based upon data submitted in connection with this artic In actual practice there are four fact which affect the situation,—the amount feed consumed, the price of the feed consu ed, the number of eggs produced, and prevailing price of eggs at the time of p duction. Respecting these factors the f lowing comments are in order: the practi poultryman has little or no control over price of eggs or the price of feed; under dinary conditions of practice the avera amount of feed consumed per bird fr month to month is fairly stable; the practi poultryman has direct control of the rate production. There is some variation in fe prices from season to season throughout year but not nearly to the same extent pertains to egg prices, and it is this feat especially that precludes the possibility applying the results respecting the financ outcome shown herein to any other situati

Mitchell (1921) has expressed the same idea, in discussing the question of the financial phases of feeding experiments. "All statements made of the monetary cost of gains and of the profits returned from any experimental feeding operation are necessarily not experimental results, since they depend so largely upon the factors not under experimental control and not subject to any predictable variation, i. e., the prevailing market prices of feeds and live stock" (p. 271). The fact that the situation respecting the prices of the feed and eggs used in this paper probably will never apply in like manner to any other group of birds makes it impossible to draw deductions concerning costs and profits for conditions ordinarily prevailing. At the same time, because of the relatively great economic significance of the extreme variations in egg prices from season to season it is highly desirable to gain as clear a conception as possible concerning the relative value of the rate of production for the different months of the year, the value of the rate of production being affected directly by the price of eggs during any particular month.

The Source of the Data

The data presented in this article were secured from the records of groups of Barred Plymouth Rocks and S. C. Rhode Island Reds kept under ordinary conditions of management at Macdonald College and cover a three-year period from November 1918 to the last of October 1921. During the months of November to April inclusive the number of birds in each breed remained fairly constant. During May and June considerable culling was practiced, which resulted in reducing the numbers somewhat. Careful records were kept of the kind and amount of feeds consumed each month and the egg production was also recorded.

The custom regarding the method of feeding consisted of giving scratch grain morning and evening and dry mash in self-feeding hoppers, which remained open continuously. Occasionally a small quantity of wet mash was fed at noon. It should be pointed out that no skim milk was fed, owing to its unavailability, and this doubtless had an adverse effect upon egg production. Grit and oyster shell were fed *ad libitum* and mangels were supplied as green food from November to the middle of April each year.

The monthly prices of eggs, shown in Tables VII and VIII, are the prices actually realized for the eggs produced for the period under discussion. It will be realized that the prices quoted for the spring and summer months are relatively higher than prices prevailing for the same seasons prior and subsequent to this particular period. The feed prices are also higher than for other years and are the actual prices paid for the different feeds used. The cost price per ton of the different feeds was: scratch grain, $72.75; mash, $63.85; green food, $5.00; oyster shell, $28.00; grit, $20.00. The prices of green food, oyster shell, and grit are fairly stable factors, there being but little change from year to year. The prices of scratch grain and mash, however, both vary considerably from year to year, and even from time to time within any one year. This is a point which the small operator in particular must always keep in mind. The Department of Poultry Husbandry at Macdonald College, however, has made a practice of purchasing its feed in carload lots and this feature has tended toward a stabilization of prices paid, with the result that for the period under discussion the feed cost of producing eggs remained as a relatively constant factor. Therefore, the two chief factors in the economic relationship between feed consumption and egg production in respect to the data under consideration are seen to be the rate of production and the price of eggs.

Discussion

Inasmuch as this paper is mainly concerned with demonstrating the relative value of the monthly distribution of egg production, but little discussion is necessary concerning the data given in Tables I to VIII. In Tables I and II are given, respectively, the amounts of the various kinds of feed consumed monthly by Barred Plymouth Rocks and S. C. Rhode Island Reds. The Barred Plymouth Rocks consumed annually, on the average, 71.21 lbs. scratch grain, 26.23 lbs. mash, 97.44 lbs. total grain, 12.34 lbs. green food, 1.86 lbs. oyster shell, and 0.76 lbs. grit, making a total feed consumption of 112.41 lbs. The average production

per bird was 136.90 eggs. It is interesting to compare these results with those secured in pens of ten birds each entered in the laying contests from 1913 to 1918, conducted by the Storrs Agricultural Experiment Station. Kirkpatrick and Card (1919) report that the average annual feed consumption per bird, covering the five-year period mentioned, in Barred Plymouth Rocks was 41.10 lbs. scratch grain, 62.30 lbs. mash, 103.40 lbs. total grain, 0.18 lbs. charcoal, 2.49 lbs. oyster shell, and 0.81 lbs. grit, making a total feed consumption of 106.88 lbs., minus green food. The average production per bird was 159.30 eggs annually. The Macdonald S. C. Rhode Island Reds consumed annually, on the average, 68.53 lbs. scratch grain, 23.61 lbs. mash, 92.14 lbs. total grain, 9.69 lbs. green food, 2.03 lbs. oyster shell, and 0.76 lbs. grit, making a total feed consumption of 104.63 lbs. annually. The average egg production was 146.40 eggs. At Storrs the average annual feed consumption per bird, in Rhode Island Reds, was 41.10 lbs. scratch grain, 58.40 lbs. mash, 99.50 lbs. total grain, 0.16 lbs. charcoal, 2.42 lbs. oyster shell, 0.69 lbs. grit, making a total feed consumption of 103.77 lbs., minus green food. The average production was 148.00 eggs annually. A comparison of feed consumption and egg production between the Storrs and Macdonald birds is rather interesting, inasmuch as the results in one case were secured under laying contest conditions, with ten birds per pen, and in the other case under commercial conditions, with about forty birds per pen. Moreover the data shown in the table accompanying this paper are among the first to be given in detail for flocks other than laying contest flocks.

Tables III and IV show the monthly consumption per bird of the various kinds of feed and the monthly egg production per bird. The former is quite stable while the latter is quite variable from month to month. It will be noted, of course, that the feeding of green food during the winter months increased the monthly consumption of total feed for that period.

Tables V and VI show the value in cents of egg production and feed consumption per bird. Naturally the value of the feed consumed from month to month is relatively stable, but since the number of eg laid per bird varies considerably fr month to month and since the price of eg also varies from month to month it follo that the value of the eggs laid monthly p bird is a highly variable factor. The re tionship of these factors is shown in D grams I and II, the monthly feed cost p bird and the price of eggs per dozen bei shown as distributed on a percentage bas Where poultry feeds can be purchased sufficiently large quantities to make the fee cost factor a relatively stable one, the proble of importance is to determine the econom relationship between the rate of egg pr duction for any given month and the pri of eggs for that month.

This is the information which is broug out in Tables VII and VIII. Incidental there are other important features contain in these tables. It will be seen, for instanc that the number of pounds of total feed r quired to produce one dozen eggs varies co siderably from month to month. Two fa tors affect this situation: providing gre feed for the winter months and the rate egg production per month. The number pounds of grain required for each doz eggs produced also varies from month month, but this is affected only by the ra of egg production per month. Another fe ture of interest is the proportional cost grain to total feed; in the case of the Ba red Plymouth Rocks the percentage gra cost to total feed cost amounts to 98.36 f the year, and in the case of the S. C. Rho Island Reds it amounts to 98.20 for t year. These figures show how relatively im portant are the prices paid for scratch gra and mash as compared with the prices pa for green food, oyster shell, and grit. Th feature is also borne out by a comparis of the average amounts of the various kin of feed consumed per bird. From Table it is found that the percentage consumptio in Barred Plymouth Rocks was: scrat grains 63.35; mash 23.33; total grain 86.6 green food 10.98; oyster shell 1.65 and gr 0.68. From Table II it is found that t percentage consumption in S. C. Rhode I land Reds was: scratch grain 65.50; mas 22.55; total grain 88.05; green food 9.2 oyster shell 1.94; and grit 0.72. The pe centages of grain to total feed are 86.6 and 88.05, respectively, for the two breed

Table I Showing Feed Consumption in Pounds and Egg Production in Barred Plymouth Rocks

Month	No. of Birds	Pens	Scratch Grain	Mash	Total Grain	Green Food	Oyster Shell	Grit	Total Feed	Eggs
Nov.	500	12	2978.60	885.15	3883.75	857.02	82.81	38.40	4821.98	3097
Dec.	480	11	2898.18	998.18	3894.34	843.50	81.08	40.27	4859.17	4210
Jan.	480	11	2832.15	976.50	3808.65	782.00	75.07	35.53	4681.25	5515
Feb.	459	11	2789.40	1078.00	3847.40	718.07	84.31	33.76	4683.54	6387
Mar.	457	11	2872.50	1143.33	3815.83	608.45	71.57	36.21	4532.08	6842
Apr.	456	11	2704.98	1111.42	3816.38	312.66	85.43	30.18	4224.65	6712
May	417	10	2489.95	807.00	3296.95	-	44.03	10.84	3351.82	5520
June	243	7	1446.57	474.98	1921.55	-	30.76	6.43	1958.74	2887
July	135	4	803.52	229.16	1032.68	-	25.55	4.17	1082.40	1391
Aug.	134	4	745.05	288.44	1031.49	-	29.47	7.83	1068.79	1244
Sept.	134	4	663.31	362.50	1025.81	-	22.00	6.18	1053.99	978
Oct.	132	4	657.74	361.83	1019.57	-	26.43	3.98	1049.98	905
Totals			23659.91	8714.49	32374.40	4101.70	618.49	253.78	37348.37	45486
Avg. per Bird			71.21	26.23	97.44	12.34	1.86	0.76	112.41	136.90

Table II Showing Feed Consumption in Pounds and Egg Production in S.C. Rhode Island Reds

Month	No. of birds	Pens	Scratch Grain	Mash	Total Grain	Green Food	Oyster Shell	Grit	Total Feed	Eggs
Nov.	300	7	1726.67	486.75	2213.42	451.50	39.15	23.30	2727.37	2011
Dec.	300	7	1779.25	579.58	2358.83	408.00	47.36	24.81	2838.80	2947
Jan.	298	7	1716.60	654.12	2370.72	398.16	53.11	27.83	2849.82	3874
Feb.	297	7	1798.05	555.50	2353.55	417.25	52.88	22.15	2845.81	4596
Mar.	296	7	1744.44	683.42	2427.86	308.64	55.75	23.76	2816.01	4638
Apr.	296	7	1758.59	597.00	2355.59	118.14	42.83	18.05	2534.41	4502
May	212	5	1171.25	413.50	1584.75	-	31.75	7.86	1624.36	3136
June	138	4	783.50	240.17	1003.67	-	24.66	4.53	1032.86	1874
July	138	4	747.63	241.05	988.68	-	32.55	5.00	1026.23	1487
Aug.	108	3	536.00	222.28	758.28	-	18.16	2.45	778.89	1187
Sept.	107	3	554.19	217.40	771.59	-	20.36	3.18	795.13	918
Oct.	105	3	563.42	228.37	791.79	-	22.50	3.17	817.48	674
Totals			14859.59	5119.14	19978.73	2101.69	440.84	165.69	22686.95	317444
Ave. per Bird			68.53	23.61	92.14	9.69	2.03	0.76	104.63	146.40

In Diagrams I and II are shown, respectively, the percentage egg production necessary to pay for feed and the percentage production realized in Barred Plymouth Rocks and S. C. Rhode Island Reds. The difference between the two percentages gives what is called the 'excess' production. Then by comparing the difference between the monthly values of eggs minus the cost of the total feed to produce them, obtained from Tables V and VI, with the monthly rates of excess production, given in Tables VII and VIII, some idea is gained of the relative value of the rate of production for each month. In order to make this feature stand out clearly in the diagrams the value of the excess production for each month is calculated on a percentage basis of ten. The whole matter may be illustrated clearly by reference to specific cases. In the case of the Barred Plymouth Rocks the percentage egg production necessary to pay for feed in the month of October was 16.39, and the percentage egg production realized was 21.47, giving in percentage an excess production of 5.08, which yielded a percentage profit over feed cost of 34.99. An excess production of ten percent would give a percentage profit over feed cost of 68.88. Likewise, an excess production of ten percent in the month of April would give a percentage profit over feed cost of 41.75. October production is shown to be worth $68.88 \div 41.75 =$ 1.65 times as valuable as April production. The major factor responsible for this situation was the difference in the price of eggs in April as compared with October. The same situation prevails in respect to the S. C. Rhode Island Reds. January production is shown to be worth $68.86 \div 44.63 =$ 1.54 times as much as April production. Viewing both diagrams it will be seen that the rate of production in Barred Plymouth Rocks and S. C. Rhode Island Reds reached the highest values during the months of August to February. The factor of primary importance in affecting the value of the rate of monthly production is shown to be the monthly price of eggs. It is this feature which makes the business of egg production assume a different aspect from the business of producing many other staple products.

The object of the practical poultryman should be to secure the largest possible egg production from his flock from August February. This implies the development strains of poultry which will commence ing much earlier than is now the case in dinary practice. The several problems volved in the development of such str will be considered in a subsequent pap

SUMMARY

The average amount of feed consum annually in Barred Plymouth Rocks been shown to be: scratch grain 71.21 l mash 26.23 lbs., total grain 97.44 lbs., gr food 12.34 lbs., oyster shell 1.86 lbs., 0.76 lbs., and total feed 112.41 lbs. pressed in terms of percentages, the c sumption was: scratch grain 63.35, m 23.33, total grain 86.68, green food 10. oyster shell 1.65, and grit 0.68.

The average amount of feed consum annually in S. C. Rhode Island Reds been shown to be: scratch grain 68.53 l mash 23.61 lbs., total grain 92.14 lbs., gr food 9.69 lbs., oyster shell 2.03 l grit 0.76 lbs., and total feed 104.63 Expressed in terms of percentages, the c sumption was: scratch grain 65.50, m 22.55, total grain 88.05, green food 9. oyster shell 1.94, and grit 0.72.

The rate of consumption per bird of various kinds of feeds remained fairly c stant from month to month in both breed

The number of pounds of total feed a the number of pounds of grain required produce one dozen eggs have each b shown to vary considerably from month month in both breeds.

Based upon the feed prices quoted in context, it has been shown that the perc tage grain cost to total feed cost was 98 for the Barred Plymouth Rocks and 98 for the S. C. Rhode Island Reds.

The Barred Plymouth Rocks produced average of 136.90 eggs each.

The S. C. Rhode Island Reds produced average of 146.40 eggs each.

The rate of production has been sho to vary considerably from month to mo in both breeds.

It has been shown that the value of rate of monthly production is determi primarily by the prevailing price of e at the time of production.

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Table III Showing Pounds Feed Consumed and Egg Production Per Bird in Barred Plymouth Rocks

Month	Scratch Grain	Mash	Total Grain	Green-food	Oyster Shell	Grit	Total Feed	Eggs
Nov.	5.96	1.77	7.73	1.71	0.12	0.08	9.64	8.19
Dec.	6.30	2.17	8.46	1.83	0.18	0.08	10.56	9.15
Jan.	6.16	2.12	8.28	1.66	0.16	0.08	10.18	11.99
Feb.	6.03	2.35	8.38	1.56	0.18	0.07	10.20	13.91
Mar.	5.85	2.50	8.35	1.33	0.16	0.08	9.92	14.53
Apr.	5.93	2.44	8.37	0.88	0.14	0.07	9.26	14.72
May	5.97	1.93	7.91	-	0.11	0.02	8.04	13.24
June	5.95	1.95	7.91	-	0.13	0.03	8.08	11.88
July	5.95	1.70	7.65	-	0.19	0.03	7.87	10.30
Aug.	5.58	2.14	7.70	-	0.22	0.06	7.98	9.28
Sept.	4.95	2.70	7.65	-	0.18	0.05	7.87	7.28
Oct.	4.98	2.74	7.72	-	0.20	0.03	7.96	6.86

Table IV Showing Pounds Feed Consumed and Egg Production Per Bird in S.C. Rhode Island Reds

Month	Scratch Grain	Mash	Total Grain	Green-food	Oyster Shell	Grit	Total Feed	Eggs
Nov.	5.75	1.62	7.38	1.50	0.13	0.08	9.09	6.70
Dec.	5.93	1.93	7.86	1.36	0.16	0.08	9.46	9.82
Jan.	5.76	2.19	7.95	1.34	0.18	0.09	9.56	13.00
Feb.	6.05	1.87	7.92	1.40	0.18	0.07	9.58	15.47
Mar.	5.89	2.31	8.20	1.04	0.19	0.08	9.51	15.87
Apr.	5.94	2.02	7.96	0.37	0.14	0.06	8.53	15.21
May	5.35	1.89	7.24	-	0.14	0.04	7.42	14.32
June	5.53	1.74	7.27	-	0.18	0.03	7.48	13.58
July	5.42	1.75	7.16	-	0.23	0.04	7.44	10.77
Aug.	4.96	2.06	7.02	-	0.17	0.02	7.21	10.99
Sept.	5.18	2.03	7.21	-	0.19	0.03	7.43	8.58
Oct.	5.36	2.17	7.54	-	0.21	0.03	7.79	6.42

Table V Showing the Value in Cents of Feed Consumption and Egg Production Per Bird in Barred Plymouth Rocks

Month	Scratch Grain	Mash	Total Grain	Green-food	Oyster Shell	Grit	Total Feed	Eggs
Nov.	21.56	5.65	27.21	0.43	0.18	0.08	27.90	35.10
Dec.	22.79	6.92	29.71	0.46	0.25	0.09	30.51	56.44
Jan.	22.28	6.77	29.05	0.41	0.23	0.08	29.77	75.93
Feb.	21.84	7.49	29.33	0.39	0.26	0.07	30.05	80.01
Mar.	21.17	7.98	29.15	0.33	0.22	0.08	29.78	65.39
Apr.	21.47	7.77	29.24	0.17	0.20	0.07	29.68	62.56
May	21.62	6.17	27.79	-	0.15	0.03	27.97	50.74
June	21.55	6.23	27.78	-	0.18	0.03	27.99	46.53
July	21.55	5.41	26.96	-	0.26	0.03	27.25	41.21
Aug.	20.13	6.82	26.95	-	0.31	0.06	27.32	41.84
Sept.	17.82	8.63	26.55	-	0.23	0.05	26.83	36.42
Oct.	18.04	8.74	26.78	-	0.28	0.03	27.09	36.57
Totals	$ 2.52	$0.85	$ 3.37	$0.02	$0.03	$0.01	$ 3.43	$ 6.29

Table VI Showing the Value in Cents of Feed Consumption and Egg Production Per Bird in S.C. Rhode Island Reds

Month	Scratch Grain	Mash	Total Grain	Green-food	Oyster Shell	Grit	Total Feed	Eggs
Nov.	20.83	5.18	26.01	0.38	0.18	0.08	26.65	37.94
Dec.	21.47	6.16	27.63	0.34	0.22	0.08	28.27	60.61
Jan.	20.85	7.00	27.85	0.33	0.25	0.09	28.52	82.31
Feb.	21.91	5.96	28.87	0.35	0.25	0.07	29.54	88.94
Mar.	21.33	7.36	28.69	0.26	0.26	0.08	29.29	70.47
Apr.	21.51	6.42	27.93	0.09	0.20	0.06	28.28	64.62
May	19.36	6.02	25.38	-	0.20	0.03	25.61	54.88
June	20.03	5.55	25.58	-	0.25	0.03	25.86	53.16
July	19.61	5.57	25.18	-	0.33	0.04	25.55	43.06
Aug.	18.99	6.56	23.55	-	0.23	0.02	23.80	49.41
Sept.	18.74	6.48	25.22	-	0.27	0.03	25.52	42.89
Oct.	19.42	6.94	26.66	-	0.30	0.03	26.69	34.18
Totals	$2.42	$0.75	$3.18	$0.02	$0.03	$0.01	$3.24	$6.83

Table VII Showing Various Factors of Relationship Between Feed Consumption and Egg Production in Barred Plymouth Rocks

Month	Price per Dozen	No. lbs. Total Feed to Produce 1 Doz. Eggs	Cost of Total Feed to Produce 1 Doz. Eggs	No. lbs. Grain Required per 1 Doz. Eggs	Cost of Grain Required per 1 doz. Eggs	Grain Cost on Total Feed Cost	Production Necessary to Pay for Total Feed	Production Realized	Production in Excess of Necessary Production	Value of Eggs above Total Feed Cost	Relative Value of Excess Production
	cts.	lbs.	cts.	lbs.	cts.	%	%	%	%	%	%
Nov.	68.00	18.68	54.05	14.97	52.71	97.52	16.41	20.65	4.24	25.88	61.04
Dec.	74.00	13.85	40.00	11.10	38.95	97.38	15.97	29.52	13.55	84.99	62.72
Jan.	76.00	10.19	29.79	8.29	29.11	97.72	15.16	38.67	23.51	155.06	65.95
Feb.	69.00	8.80	25.92	7.23	25.29	97.57	18.49	49.25	30.76	166.25	54.05
Mar.	54.00	8.19	24.59	6.89	24.07	97.88	22.06	46.88	24.82	119.58	48.16
Apr.	51.00	7.55	24.19	6.82	23.77	98.26	22.53	49.06	26.53	110.78	41.75
May.	48.00	7.39	25.36	7.17	25.19	99.33	23.54	43.02	19.48	81.41	41.78
June	47.00	8.15	28.27	7.99	28.06	99.26	25.23	39.30	14.07	66.24	47.08
July	48.00	9.18	31.74	8.91	31.40	98.93	21.92	33.24	11.32	51.23	45.26
Aug.	54.00	10.32	35.33	9.95	34.85	98.64	19.58	29.94	10.36	53.15	51.30
Sept.	60.00	12.98	44.21	12.61	43.75	98.98	17.89	24.18	6.29	39.47	62.75
Oct.	64.00	13.92	47.42	13.52	46.87	98.84	16.39	21.47	5.08	34.99	68.88

Table VIII Showing Various Factors of Relationship Between Feed Consumption and Egg Production in S.C. Rhode Island Reds

Month	Price per Dozen	No. lbs. Total Feed to Produce 1 Doz. Eggs	Cost of Total Feed to Produce 1 Doz. Eggs	No. lbs. Grain Required per 1 Doz. Eggs	Cost of Grain Required per 1 Dozen Eggs	Grain Cost on Total Feed Cost	Production Necessary to Pay for Total Feed	Production Realized	Production in Excess of Necessary Production	Value of Eggs above Feed Cost	Relative Value of Excess Production
	cts.	lbs.	cts.	lbs.	cts.	%	%	%	%	%	%
Nov.	68.00	18.27	47.81	13.21	46.56	97.38	15.38	23.34	8.96	142.37	60.88
Dec.	74.00	11.56	34.22	9.60	33.72	98.25	14.48	31.69	17.21	214.39	66.47
Jan.	76.00	8.83	26.32	7.34	25.88	97.56	14.54	41.93	27.39	288.80	68.88
Feb.	69.00	7.43	22.84	6.14	22.32	97.72	18.34	54.77	36.43	301.08	55.19
Mar.	54.00	7.28	22.43	6.44	21.96	97.90	20.99	50.60	29.61	240.59	47.48
Apr.	51.00	6.75	22.31	6.27	21.96	98.43	22.13	50.70	28.57	228.50	44.63
May	48.00	6.31	21.46	6.06	21.24	98.97	21.69	46.19	24.50	214.29	46.65
June	47.00	6.61	22.85	6.43	22.56	98.73	22.01	45.27	23.26	205.57	45.39
July	48.00	8.28	28.45	7.88	27.96	98.28	20.60	34.76	14.16	188.53	48.39
Aug.	54.00	7.87	26.17	7.56	25.68	98.12	17.07	35.45	18.38	207.61	58.00
Sept.	60.00	10.39	35.69	10.09	35.28	98.85	17.01	28.59	11.58	188.08	58.77
Oct.	64.00	14.55	49.89	14.10	49.20	98.62	16.14	20.71	4.57	128.06	61.40

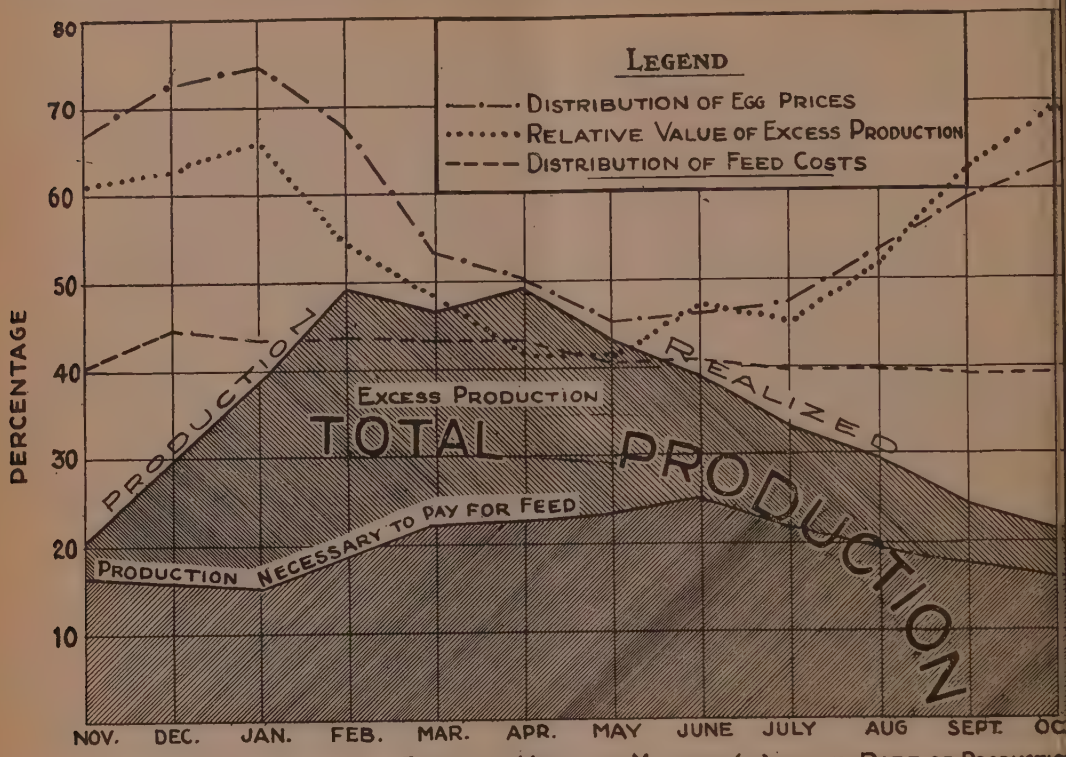

DIAGRAM I SHOWING THE RELATIVE VALUE BY MONTHS (····) OF THE RATE OF PRODUCTIO IN BARRED PLYMOUTH ROCKS

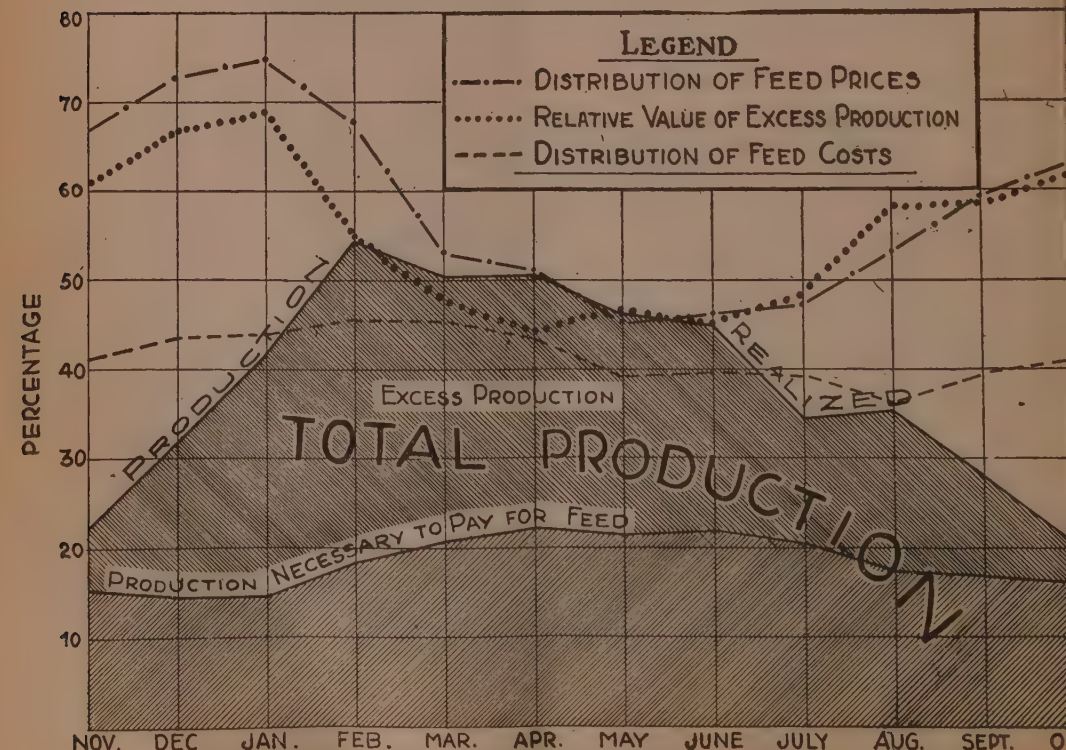

DIAGRAM II SHOWING THE RELATIVE VALUE BY THE MONTHS (····) OF THE RATE OF PRODUCTION IN S.C. RHODE ISLAND REDS.

Commercial Drug Plant Cultivation in British Columbia

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After the outbreak of war in 1914 numerous irresponsible writers contributed articles to magazines and newspapers urging the cultivation of medicinal plants in B.C. A small capital investment and big profits were held up as a special inducement to ranchers and others willing to "get rich quick." So far, I have not heard that any of the war profiteers made his wealth through the cultivation of medicinal plants.

It is quite true that values to the extent of from $2000.00 to between $7000.00 and $8000.00 per acre may be obtained for certain medicinal plants, but unfortunately this is not all profit; a fact which the writers of the articles referred to, forgot to mention.

"A little knowledge" may be "a dangerous thing" and cause serious loss to ranchers who can ill afford to venture on a gamble of this kind; for without a full knowledge of the "pros and cons", the cultivation of drug plants is a gamble. When you know that this $7000 or $8000 crop takes five or six years to mature, that there is an outlay of about $1500 per acre, that the crop may be reduced or wiped out by some of many fungous diseases or insect pests, a different complexion is given to what seemed a very attractive proposition, without considering labor costs, freight rates, and interest on capital invested.

In British Columbia we have more than forty species of wild plants which are well known for their medicinal properties. The majority can not be profitably cultivated here; some, if found in abundance in the wild state may be profitably collected for the market.

After investigating the possibilities of each from an economic point of view, I have come to the conclusion that British Columbia may prove to be an important centre for the establishment of a wholesale drug-manufacturing industry. Take for example our native Cascara tree (*Rhamnus Purshiana*). It has been estimated that 1000 tons of bark are required annually to supply the world's demands for the various preparations of Cascara sagrada. All of this is shipped from the west to eastern firms of manufacturing druggists, and freight on 1000 tons for several thousand miles has to be paid; whereas, with a manufacturing druggist established near the source of this raw material, the extract could be prepared here with an enormous decrease of cost or an enormous increase in profit.

About six or seven years ago, when manufacturing druggists turned their eyes to B.C. to supply the market with Carcara bark, I placed this proposition before a number of the largest firms in Eastern Canada, United States and Great Britain. The gist of their replies was to the effect that, as the preparation of Cascara alone would not keep a factory busy throughout the year, it would be necessary to secure local supplies of other medicinal and drug plants.

The next step was to find out what introduced species could be profitably grown on a commercial scale in British Columbia, and to ascertain whether such species grown here would yield the same percentage of drug contents as the best grown elsewhere. This last point is one of considerable economic importance. For example *Aconitum Napellus* from the Swiss Alps is worth about 40/- or 50/- per cwt., whereas the same species grown in England is worth 224/- per cwt. and an allied species (*Aconitum Fischeri* from Japan fetches only 35/- per cwt.

Belladonna (*Atropa belladonna*) leaves from America are worth 25c per lb. whereas those grown in England are $1.50 lb. Three prices are given for *Chamomile;* French 125/- per cwt., Belgian 140/- per cwt., English 336/- per cwt. (3/- per lb.).

Therefore, before I could advise growers as to what species they should cultivate, it was necessary to have B.C. grown material carefully analysed by a competent chemist, and be guided by the results of such analyses. I was glad therefore when two or three years ago Professor R. H. Clark intimated his willingness to co-operate by supervising the chemical analysis, and last year when my colleague Professor A. H. Hutchinson undertook the supervision of the biological tests, of drugs extracted from such drug plants as can be cultivated in B.C. with the prospect of being of commercial importance.

The value of such analytical work can not be over estimated, if we find that the drug-yield of any species is lower than that of the same species grown elsewhere; this knowledge will help to prevent growers raising unprofitable crops. If, on the other hand, we find that we can grow some species yielding a percentage of drugs equal to, or greater than the best now obtainable, it will help growers to secure a ready market, and the maximum price for their crops.

It should be emphasized that our prospects depend largely on our ability to maintain our position as one of the chief producers of Cascara; with this object in view the Department of the Interior has just issued a Forestry Branch Circular No. 13, entitled "The Cascara Tree in British Columbia" in which methods of conservation and propagation are described. This may be obtained free from the Dominion Forestry Branch, Ottawa, the Provincial Forestry Branch, Victoria, B.C., or at the Court House, Vancouver.

Assuming that ranchers and settlers will be sufficiently interested in the financial returns from Cascara, to encourage its growth in the vicinity of their homesteads, we may turn our attention to some other important medicinal species the cultivation of which, in some regions, may prove more profitable than the present crops, and may result in the utilization of land unsuited for agriculture or forestry.

I will not occupy your time by reciting the history of medicinal plants. You may consult books on Materia Medica and Pharmacy for the various preparations, and their effects on the human body.

Digitalis purpurea (Fox-glove)

I have observed that several British plan when accidentally introduced into B.C., gr more luxuriantly here than they do at hon Fox-glove is one of them. Much of t Digitalis used in commerce is grown in Gr Britain. During the war, when all availal land in Britain was required for growi food, there was a scarcity of Digitalis, a a consequent increase in price. In the ye prior to the war Digitalis leaves sold at 1 per pound and rose to 35c per pound in 19 Today they are about 25c per pound.

Our climate is admirably suited for *Di talis purpurea*, the species generally used commerce, and I believe we could raise greater number of pounds per acre than c be raised either in Great Britain or in t United States. But if these plants raised B. C. had a lower percentage of digital than plants raised elsewhere, our crop wou prove an economic failure. During this p year specimens have been grown, analys and tested; although I am not at liberty communicate anything of the results, I m say that so far as we have gone the pr pects are good.

With this knowledge, we are commenci experiments to ascertain the effect of vario fertilizers on the percentage of drug conten and on the yield per acre; so that when w are in a position to recommend the cultiv tion of Digitalis we will be able to advi as to the best cultural methods to adopt f the production of the highest quality of Fo glove leaves.

Conium maculatum (Hemlock). This is t Poison Hemlock associated with the death Socrates. The tree known here as Hemlo should be called Hemlock Spruce.

Hemlock is a common herbaceous plant Great Britain and on the European continen and is another of those accidently introduce species which thrives better here than in i native country. In Europe this plant ave ages about 5 ft. in height and 6 ft. would b considered a tall specimen. In B.C. it is n uncommon to find them twice that height one specimen in our collection is 11½ fe high and I am informed that other specime growing on the same vacant lot were 16 fe high.

The value of a crop of Conium per ac is greater than that of Digitalis, and we hop in the future to have sufficient material t

ascertain if its yield of Coniin is equal to that grown elsewhere.

Carum copticum (Ajowan) belongs to the same family as the Hemlock. Ajowan oil extracted from the "seeds" of this plant is the commercial source of Thymol which at the present time (March, 1922) is quoted wholesale at $8.40 per lb. It is cultivated in northern India; so, knowing that several of the native plants of that region belong to exactly the same species as we have native in B. C., I sent to India for a supply of seed to try it out in this Province. Like the other plants mentioned, it is a two year crop, and if it can stand our wet winter, it is likely to yield an abundant return. The fruits or so-called "seeds" contain over 22% of oil—Ajowan oil—which is shipped from Northern India to Northern Europe where the Thymol is extracted. If this extraction can be done by a local firm of manufacturing druggists it should provide a considerable amount of employment and revenue for B. C. The importation of Thymol into the U. S. has in some years exceeded 18,000 pounds. One point to be borne in mind is that this is a "seed" crop, and B. C. is undoubtedly the best Province in Canada for seed production.

It may be interesting to mention that one of our native plants *Monarda fistulosa* (Horsemint) yields Horsemint oil, of which about 66% is Thymol. The crop from one acre yields about 30 pounds of oil or 20 pounds of Thymol which at the present price is worth over $160; the grower would receive about $40 or $50 per acre. It is an easy crop to handle, it can be mowed with a reaper, and cured like hay; but it is doubtful if it can be regarded as a profitable crop to cultivate here.

Mentha piperita and M. spicata (Peppermint, and Spearmint.) While discussing the prospects of producing Ajowan oil or Horsemint oil, I may refer to the possibilities of the commercial production of oil of peppermint and spearmint. We frequently have inquiries regarding suitable crops for muck lands, and though the mints can be grown on good soil, they do quite well on what are known as muck lands which are not so well suited for ordinary agricultural crops. A local firm prepared to undertake the distillation of these oils would encourage the utilization and cultivation of considerable areas near Vancouver. In March 1922 pepermint leaves were quoted wholesale at 75c per pound; the average yield per acre is estimated at 600 pounds.

Atropa belladonna is cultivated as a medicinal plant in Great Britain and, being a perennial, is one which should be profitable in the coast area of B. C. The crop is valued at over $150 per acre, the annual crop of foliage alone being worth from $100 to $120 per acre and if one decides to plant some other crop to give the ground a rest, the roots from one acre are worth from $60 to $90. There is a considerable demand for the roots and leaves of this plant for the manufacture of various drugs used in medicine. Though I have not had an opportunity of testing this in B. C., I have reason to believe it will do well here.

Another plant, closely related to Belladonna, is *Hyoscyamus niger* (Henbane), a biennial which fetches from $2100—$2280 per acre. It yields about 6000 pounds of leaves, flowering tops, and seeds per acre. At the present time leaves are quoted wholesale at 42c pound bringing the value of the crop per acre well on to $2500. As this is a two year crop the annual gross revenue would be over $1000 per acre. I have seen this grown in the North of Scotland and have no doubt that in our climate it would do much better than it does there.

Hydrastis canadensis (Golden Seal). This plant is a native of Eastern Canada, but is cultivated by many people, both in Canada and the United States. Owing to the fact that few ranchers can afford to wait five years for financial returns, plantations are usually on a small scale, and no doubt the high prices which now prevail will induce many to try their luck or success in raising Golden Seal. An acre of this crop when well grown may realize $7750. The root is used in the preparation of medicine for digestive disorders and catarrhal affections of the mucous membranes and is in great demand at the present time. To ensure an annual revenue it is necessary to have sections planted with seedlings and successively older plants up to five or six years, at which age they are marketable. When lifting the roots for the market, small portions suitable for replanting may break off; these may be used for propagation instead of raising from seed. When the roots are lifted, the ground

should be dug and a liberal supply of well rotted leaves incorporated. This means that one has to look after 5 or 6 acres for the revenue from one acre, and the crop requires considerable care and attention. It will not do well unless grown in shade; this is usually accomplished by a lath structure raised on posts 7 or 8 feet above the ground. Care has to be taken at all times to see that the plants do not suffer from drip during wet weather, and that water is not allowed to accumulate round the roots. They must be watered when the soil tends to dry out, and weeds must be kept in check. The soil can not be deeply cultivated while the crop is in. because the roots are near the surface. It has been estimated that the cost of establishing a Golden Seal plantation, including the cost of seeds or plants, lath house, preparation of ground, fertilizers, labor, etc., is approximately $1,500 per acre. It is of course possible to do it for much less, especially by a handy man with access to a good supply of "Cedar" which can be split into laths, and with plenty of spare time during the winter to erect the lath house. One should bear in mind however that the structure has to last until the crop is mature, which, if started from seed will take five years.

It is estimated that from 1500-2000 pounds of dry root can be got from one acre and, as the root sells at from $5 - $6 per pound the maximum crop and price would mean a revenue of $12,000 per acre; you will see therefore that I was fairly conservative in placing the average value at $7750.

Panax quinquifoium (Ginseng). There are more people interested in the collection and cultivation of this plant than in the cultivation of any other medicinal species on this continent. The roots bring from $5 to $8 per lb. according to quality. Large sums are occasionally paid by the Chinese for individual roots which must be free from blemishes, and the more closely its shape resembles the form of a human being—with body, arms and legs—the more valuable it is, not for medicinal purposes, but for what it means when presented to a Chinese bride; and if a bride has many wealthy friends she may receive many such presents as charms which ensure her success, happiness and many children. Perhaps this is the reason why the yellow races outnumber the white, and perhaps the reason why the cultivati of Ginseng in Japan is controlled by t Japanese government; we may not be ab to produce scientific proof but we have the two facts in support of it: (1) the vast bu of the Ginseng collected or cultivated shipped to China, and (2) the Chinese are t most prolific race on the earth.

There are differences of opinion regardi the value of Ginseng as a medicinal pla nevertheless one occasionally sees adverti ments of medicines, with Ginseng listed one of the ingredients, and whether or n it may be included here as a medicinal pla there is a great demand for it, and the hi price paid seems to offer reasonable co pensation for the work of cultivating it. M chief reason for dealing with it here is b cause it is a crop in many respects simil to Golden Seal; it takes five or six years mature, must be grown in shade and giv the greatest care and attention because it susceptible to a greater number of fungo and insect diseases than Golden Seal.

If this plant can be raised successfully British Columbia it should be the source considerable revenue. In connection wi our work on medicinal plants, I have ju started an experimental plot containing few thousand seedlings and one and tw year old Ginseng plants growing under co ditions approximating those required f commercial culture. Our object is to asce tain what growth this plant—which by-th way *is not* a native of British Columbia—wi make in our climate, and whether our pla are susceptible to any of the diseases whi occasionally play havoc with Ginseng cro in the United States. I hope also to car out some experiments with selected fertili ers in relation to vigor and resistance to di ease.

Datura stramonium (Thorn Apple). Ea year, for the past nine years, I have grown little of this plant, originally obtained fro the fruit of a specimen found wild in t Fraser Valley and sent in to be identified. is an annual crop and does well in B. C

The price of this plant is liable to gre fluctuation, ranging from $85 to nearly $6 dollars per acre. It yields from 1000 - 15 pounds of leaves and from 500 - 2000 poun of seed per acre, and both are marketabl At the present time leaves are quoted whol

le at 40c per lb. bringing the value of an erage crop of leaves alone up to about 00 per acre. The seeds in 1920 were 12c r pound or $150 for an average crop, mak- g a total value of $750 per acre. But be- re definitely recommending the cultivation this plant in B. C. I hope to have it an- yzed and tested to make sure that it is high in drug contents as plants grown else- here.

It should be mentioned that there is a nited demand for this plant; the leaves are ed in burning powders for asthma, the eds contain a powerful narcotic which is escribed in small quantities, so that if erybody started growing this plant the arket would soon be glutted.

I can not, in a short paper, discuss the mer- of each of the fifty-five medicinal species entioned on the list which I have drawn to show our wild medicinal plants d those which may be cultivated in B.C., t I would like to add a few remarks about e utilization of some of our wild species hich are at present going to waste. In me cases children could make quite a lit- pocket money, and at the same time aid exterminating weeds which take posses- on of our lawns and boulevards.

I was greatly interested the other day to te that the wholesale price of Dandelion- ot is 35c per lb. There are millions of andelions on the lawns and boulevards of reater Vancouver and they seem to have in- eased rapidly since the passing of the ohibition Act; yet, when one considers the merous appliances available for grubbing t Dandelions, it is surprising that drug alers should find a scarcity of this root. has frequently been cultivated on a com- ercial scale both in England and in the S.; the crop, collected in the fall of the cond year brings from $100 to over $400 r acre, producing from 1000 - 1500 pounds dried root.

Another weed which is an eyesore on ulevards and waste ground in our locality *Arctium lappa* (Burdock). This forms rrot-like roots which, when sliced and ied, are sold at 35c per pound wholesale. March, 1922). Two years ago this was rth 12c per lb., and even at this price is rth from $180 - $240 per acre cultivated an annual crop. At the present price it ould be worth about $500 or $600 per acre, the yield being from 1500 - 2000 pounds of dried root.

The latest quotation for Balm of Gilead buds is $1.50 per lb. One of our native Poplars (*Populus trichocarpa*) is so closely related to the species known in the East as Balm of Gilead, that about 2 years ago 1500 pounds of buds were shipped from B. C. and found to be of equal value for medicinal purposes. This species is quite common in the coast area especially in the lower Fraser Valley, and is plentiful around Vancouver.

The leaves of the true Bearberry (*Arctostaphylos uva-ursi*) which is so common in some parts of B.C. and common on rocky bluffs on the north shore are quoted wholesale at 30c per pound (March, 1922.) The plant is a low trailing evergreen shrub whose leaves are used in the preparation of medicines for affections of the kidney and bladder. This plant should not be confused with the Cascara tree which is sometimes erroneously referred to as Bearberry.

At the present time when "back to the land", "work and provide work to reduce unemployment", and many other slogans are ringing in our ears, it is fitting that we should discuss the prospects for the establishment of a drug manufacturing industry in this Province, as the basis for drug-plant farming. With British Columbia's climate, native flora, and long growing season we have advantages over all other Provinces in Canada, and most of the United States, and if we make use of these advantages, we may contribute much to the prosperity not only of Canada but of the British Empire.

A former colleague of mine has been retained by the Government of India for a period of three years to supervise the establishment of a Cinchona plantation in Burmah, so that the British Empire may be independent of foreign supplies of quinine. British Columbia is the only part of the British Empire in which the Cascara-tree is native and if we are to continue to contribute our share of this valuable medicine, it is time that steps were taken to conserve and increase our supplies. If, in addition, we can contribute other medicinal plants formerly supplied by foreign countries, we will not only strengthen our position in the Empire, but will add to our revenue many hundred thousands of dollars, which in a few years may run into millions when drug-plant farming becomes an established industry.

Free Growing Roses for the Home Garden*

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In all parts of this Dominion roses in a wild state are found varying in form and beauty of growth, flower and fruit. Thus it is perfectly in order for us to be concerned with the cultivation and arrangement of North American native types, their varieties and hybrids as well as the rose aristocrats of other countries which have been given to us by careful cross-breeding and selection.

The wild or native types with their hybrids, whether bushes or climbers with their free flowering habits, interesting hips (fruits) and hardiness, have a place in our landscape. They also succeed in locations less favoured, as clumps, background or borders, amongst tree stumps or rocks or near the water's edge. Some make good hedges and thickets.

Among the native species and their hybrids are *Rosa setigera* (climbing), *palustris, blanda, carolina, virginiana* and *nitida.* The first one is the best known with its hybrids, of which Baltimore Belle and Queen of the Prairie are the best known, whilst American Pillar owes its origin to *Setigera* and *Wichuraiana* cross. True these native types may be placed in more public spots but perhaps the more beautiful foreign species and introductions brought about by happy matings should be given pre-eminence.

Thus this free flowering, vigorous growing class is used in naturalistic effects with the best results possible, but the more rigid type, larger flowering and probably more beautiful and more fragrant class known as T's, H.T's and H.P's are better for set or formal beds or rows.

The largely free-flowering and more vigorous type is what concerns the writer largely in this paper. Some are particularly adapted for covering arches, pergolas, summer houses, garages, walls, fences, poles, old tree stumps, rocks, etc. Some wonderfully graceful accentuations may be brought about as well as beautiful hanging effects. The following are a few of the foregoing types:

(1) The Sweet Brier (*Rosa rubiginosa*), from Europe is especially attractive with its aromatic foliage. What is more entranc than the Sweet Brier perfume after a sho or on an evening in summer? The hyb known as Lord Penzance briers are har very free flowering, showy and fragrant iage, and have interesting hips in fall winter. These are splendid for hedges massing in the border or clumps on lawn.

Lord Penzance's Hybrid Sweet Briers:

Amy Robsart, lovely deep rose.
Anne of Geierstein, dark crimson.
Brenda, maiden's blush.
Flora McIvor, white, flesh rose.
Lady Penzance, copper, base of petals yell
Lord Penzance, soft shade of fawn, yellow centre.
Lucy Ashton, white, pink edges.
Lucy Bertram, deep crimson.
Meg Merrilies, brilliant crimson.

(2) *Rosa multiflora*, from Japan a China, is very hardy, vigorous and free fl ering. It has given us many climbing v ieties and hybrids, especially when cros with *R. Wichuraiana.* The following first-rate Multifloras:

American Pillar, pink, yellow stamens.
Crimson Rambler, white.
Philadelphia Rambler, crimson, double.
Flower of Fairfield, crimson, constant bloo ing.
Tausendschon, pinkish carmine.

The Dwarf Polyantha roses are offsho of *Multiflora* through crossing with *R. indi* These are called the Polyantha pompon cl or Dwarf or Baby Rambler and are excell for massing in beds on lawns or for pot c ture. They are continuous in flowering a are delightful. This list is excellent:

Mme. Levasseur, pinkish red.
Aennchen Muller, bright pink.
Cecile Brunner, bluish white, shaded pale r
Eblouissant, brilliant deep red.
Echo, pale pink, semi-double, large flowers.
Etoile Luisante, carmine and coral pink.
George Elger, yellow.
Jessie, brilliant red.
Katherine Zeimet, white.
La Marne, salmon pink, semi-double.
Mrs. W. H. Cutbush, pale pink.
Rodhatte, clear cherry red, single large flowe
Yvonne Rabier, white.
Helen Poulsen, bright cherry rose.
Perle d'Or, Nankeen yellow, orange centre.

*An address before the Ontario Rose Society, Toronto, December, 1922.

(3) Closely associated with the *R. Multiflora* is *R. Wichuraiana.* It is commonly called the Memorial rose and sometimes creeping rose. Many of our so-called ramblers like Dorothy Perkins are Hybrid Wichuraianas. These hybrids are particularly adapted for climbing and covering. Like most climbers and Briers cutting out the old past-flowering growths is necessary and some shortening of the very vigorous new growth. The following list is a good one:

Dorothy Perkins, shell pink.
Hiawatha, crimson, white eye, yellow stamens.
Excelsa, bright scarlet, double.
White Dorothy Perkins, white.
Gardenia, best yellow, double.
Dr. Van Fleet, flesh peach pink.
Christine Wright (Testout x H. W.), rose pink.
Silver Moon, large silvery white.
Evangeline, white, top of petals pink.
Minnehaha, deep rose.
Alberic Barbiere, semi-double, creamy to yellow.
Paul's Scarlet Rambler, vivid scarlet to crimson.
Aviator Bleriot, saffron yellow.

(4) *Rosa Sempervirens* (Evergreen rose) is akin to *R. Wichuraiana.* Its foliage is more tenacious. A good example is Felecite Perpetue—creamy white.

(5) The Japanese rose, *Rosa rugosa,* is most hardy, attractive with large flowers, glossy foliage and tenacious orange red hips. It is splendid for hedges and thickets. The new *rugosa* hybrids are striking, especially Conrad Ferdinand Meyer, a bright rose, double, and Nova Zembla, a white with a slight pink flush. A splendid recent variety is Agnes—a cross with Rugosa and Persian yellow, a double, and in colour pale amber, fragrant. The following are also first-class:

Rosa rugosa alba, pure white, single.
Rosa rugosa rubra, rose, single.
Blanc double de Coubert, pure white, semi-double.
F. J. Grootendorst, bright red, small, double.
Mme. Georges Bruant, white, semi-double.
Mrs. Anthony Waterer, deep crimson, semi-double.
Rose a parfum de l'Hay, brilliant red, very fragrant.
Rose Apples, pale carmine rose.
Roseraie de l'Hay, dark red, double.
Souvenir de Philemon Cochet, pure white, double.
Dolly Vardon, light apricot, pink to yellow.

(6) Perhaps among the roses the most attractive in colour, of the brier or rambler type or decorative type, are the Austrian briers, *Rosa foetida.* The copper coloured Austrian brier is especially so. The variety Harrisonii - a double yellow - is very fine, more so than Persian yellow, the old favourite double yellow.

(7) *Rosa Hugonis* (*asia*) of the section of Pimpinellifollæ is proving itself hardy in North America. It is of a shrubby type, six feet tall with flowers two-and-one-half inches across; yellow in colour and very floriferous with handsome scarlet hips. It should be grown here successfully. Great results are expected from its crosses.

(8) The Pernetiana or Austrian hybrids are crosses with the Hybrid Tea and Austrian brier and are very popular. The new type is vigorous in habit like the H.T's but has strong tendencies toward the brier in thorns and foliage.

M. Pernet Ducher of Lyons, France, is responsible for this new class. A variety was seen recently at the Royal Winter Fair. It is a glorious yellow, named Souvenir de Claudius Pernet. There are thorns on the flower stem which may prevent its popularity in some instances. The best known of Pernetians are Soleil d'Or, a lovely reddish gold, and Mme. Edouard Herriot, a beautiful flame shaded with terra cotta. The following are among the best and most promising:

Constance, bright golden and canary yellow.
Gottfried Keller, deep yellow, suffused pink.
Mrs. Farmer, Indian yellow, reverse of petals apricot.
Isobel, orange scarlet, single.
Willowmere, shrimp pink.
Rayon d'Or, yellow cadmium, first claret then sunflower yellow.
Mrs. T. Hillas, chrome yellow, hardy, fine form.
Arthur H. Goodwin, coppery orange red.
Juliet, old gold outside, rosy red inside changing to deep rose.

(9) A new rose in the H. P. class is Eugene Barbiere. It is especially recommended. Enormous round bud. Deep golden yellow, sometimes tinted copper red. Flowers almost solitary on long stem, very large, cup shaped, attaining six inches in diameter, of a very fine colour, canary yellow, very brilliant. Shaded a golden yellow, slightly coppered. Vigorous and erect growth, very floriferous, all branches carrying their flower. Bright green foliage, branches stout, nearly spineless; very fine plant. Parentage, Frau Karl Druschki and Reine d'Or.

Pourquoi Cultiver les Plantes-Racines ?

JOSAPHAT JOYAL,

St. Casimir de Portneuf, P.Q.

Si, dans l'ordre moral, un bien engendre un autre bien, de même, dans le monde industriel, une exploitation en amène une autre. Ainsi, dans l'agriculture, l'exploitation d'une ferme, conduite sur une base d'affaires, comporte nécessairement plusieurs cultures. N'est-ce pas l'industrie laitière qui a amené l'élevage du porc dans la province de Québec? A un autre point de vue, la même industrie a contribué pour une bonne part au développement de certaines cultures telles que celles des plantes-racines et plantes fourragères. Ces cultures furent un bienfait à plusieurs points de vue sur nos fermes.

D'abord, les plantes-racines sont excellentes pour l'alimentation des vaches laitières; de plus, elles ont une place importante dans le rotation.

Voici ce que disait un vieil agronome français, au congrès international de Paris: "Nulle plante n'améliore le sol et n'est favorable aux récoltes subséquentes comme la betterave et dut-elle ne me rien rapporter, je continuerai à la cultiver tant sont grands ses avantages pour l'amélioration de mes terres et pour les cultures qui suivent." Il est facile de se rendre compte de la vérité de cette assertion, quand on sait que ces plantes ont des exigences différentes des autres cultures telles que l'avoine et le foin. Les racines, et effet, demandent pour la production de la tige, des feuilles et des racines une énorme quantité de nourriture spéciale c-à-d. des nitrates. D'autres cultures comme les céréales, réussissent mieux avec une moindre quantité de nitrates, mais il leur faut en plus des phosphates. La culture des plantes-racines est donc nécessaire pour une bonne rotation.

De plus, la culture des racines offre l'avantage de détruire les mauvaises herbes plus facilement par les travaux de culture qu'elles exigent. Tous les éléments qui seraient enlevés au sol par la moutarde, nielle, etc., sont ainsi laissés à la disposition du grain ou du fourrage. Et ceux qui se trouvent entermés dans le sous-sol sont utilisés par les plantes-racines qui seules peuvent aller puiser à une profondeur de 1 pied et même 2 pieds dans le sol.

Cet enfoncement des racines a aussi un autre effet: il ouvre la couche arable à l'air et à l'eau, concourant ainsi à donner au terrain une meilleure texture.

Enfin, les services que les betteraves, rutabagas, rendent aux cultivateurs par leurs bons effets dans l'alimentation des troupeaux, militent en faveur des plantes fourragères. Voici ce qu'en dit l'auteur de "Feeds and Feeding": "En addition aux autres aliments, les racines sont un tonique bienfaisant, pour les animaux et aident à conserver un troupeau d'élevage en bonne condition." Beaucoup d'éleveurs recommandent fortement les racines, continue-t-il,, pour les animaux d'exposition ou les vaches que l'on pousse à un maximum de rendement en lait. On a démontré à la Ferme Expérimentale du Michigan que les racines additionnées à une ration bien balancée et un bon ensilagè augmentaient la production du beurre de 5.8%. Donc, si l'on s'en tient au coût de production moyen des plantes fourragères qui est d'environ

$5.00 la tonne, suivant les rapports des stations d'illustration fédérales, le profit de cette culture ne peut être mis en doute. Cependant pour être économique dans cette exploitation, il faut au préalable connaître les conditions et les travaux spéciaux exigés par ces plantes.

Les directeurs des Fermes Expérimentales s'accordent tous à dire que le meilleur terrain pour avoir de bons rendements est un sol sablo-argileux. Les terres argileuses et compactes demandent auparavant d'être drainées et bien préparées.

Quant à leur place dans la rotation, les racines préfèrent un retour de trèfle ou une jachère d'été.

Les travaux du sol sont importants au plus haut point. Le labour doit avoir au moins 7 pcs de profondeur et l'on doit choisir de préférence une terre parfaitement égouttée dès l'automme, afin que celle-ci se réchauffe vite au printemps. Une expérience a été conduite sur la Ferme Expérimentale à Ottawa, démontrant que le labour profond apportait $2.00 de bénéfice par arpent. En plus on remarquait que toutes les récoltes suséquentes étaient supérieures à celles faites sur labour mince.

Le labour d'automme est aussi préférable à celui du printemps. Il nous donne alors la facilité d'enfouir un peu de fumier par un léger hersage.

Le fumier ne doit pas être employé trop vert. Il faut qu'il soit un engrais complet, c-à-d pas trop décomposé. Il doit contenir de l'azote et de la potasse surtout. Et soit dit en passant, la betterave est peut-être la plante qui paie le mieux le fumier qu'on lui applique. Elle s'assimile très facilement les éléments nutritifs contenus dans les matières organiques. On met en moyenne 15 à 20 tonnes de fumier à l'âcre.

Enfin la terre bien préparée, on sème le plus à bonne heure possible c-à-d, entre le 15 et le 30 du mois de mai. On commence dans les terres argileuses par donner un hersage énergique et l'on passe le rouleau successivement afin d'écraser les mottes et de pulvériser le terrain. On peut semer en billons ou à plat. Le premier semis est preferable, parce qu'il augmente la profondeur du sol et permet de faire de sarclages prematurés, sans nuir aux jeunes plantes.

Si on sème en billons, il est bon de passer le rouleau auparavant afin de rouler la terre. Les rangs doivent être à 30 pcs. de distance. On met d'ordinaire 4 à 6 lbs. de graine par âcre afin qu'il n'y ait pas de vide dans les sillons. Alors, l'on n'aura qu'à éclaircir après 4 ou 5 semaines.

Le repiquage des plantes racines est une opération présentant certains avantages, mais qui n'est pas pratiquée, parce que trop fatiguante et trop longue.

Afin d'entretenir une végétation, abondante il faut garder le sol en bonne condition; et pour cela, on bine fréquemment, surtout quand les pluies sont rares, a fin de conserver l'humidité. Quant aux terres argileuses, on les laisse un peu se ressuyer avant de passer la houe.

Puis, vient la récolte. Celle-ci ne doit pas se faire trop tard si on veut conserver facilement les légumes en cave. Règle générale, il faut la faire avant le 15 octobre. On conseille de laisser sécher les racines avant de les entrer si la température le permet. Et pour les protéger contre la gelée, on les couvre de feuilles ou de vieux tapis.

Quelles variétées doit-on choisir, lorsqu'on veut cultiver les betteraves ou les choux de Siam? Toutes sortes de variétés se vendent chez les marchands. Bon nombre d'entre elles sont les mêmes sous différents noms. D'après les essais fàits sur les Fermes Expérimentales, on peut surtout recommander les variétés demi-sucrières: Pour les betteraves, "Blanche Géante," "Intermédiaire Jaune Géante," "Gate Post."

Pour les Choux de Siam, le "Good Luck" le "Halewood's Bronze Top" le "Hall Westbury" le "Jumbo" sont fortement appréciés.

Irrigation Farming

E. A. HOWES,

Dean of the Faculty of Agriculture, University of Alberta, Edmonton.

If I may be pardoned a semi-personal reference, I would like to state that my interest in Irrigation, as an important factor in agriculture, does not begin with the present encouragement that is being given this work by the Alberta Government. I came to Alberta from an institution where irrigation farming was paramount, and I had charge of the Irrigation Station at Reno, Nevada, as well as the Dry Farm Station at Elko in the same state. During my comparatively short stay there I had sufficient experience to enable me to realize that I was only a rank beginner in the science of Irrigation, but at least I obtained, in some measure, a conception of the importance of this type of farming, and I left Nevada with two things firmly fixed in my mind—in the first place that irrigation farming is the very best kind of farming, and in the second place that careless, incompetent irrigation farming is the very meanest kind of farming. When I came to Alberta I was naturally interested to note what work had been done in Irrigation up to that time, 1913. At a certain Irrigation Convention I had the temerity to warn the then irrigation farmers that getting water on the land was only part of the game, and that adequate drainage was essentially a most important factor, and one that could not be neglected. Certain ardent spirits took exception to my remarks, and urged quite earnestly that such statements could only tend to hold back settlement. The experiences of the years immediately succeeding have furnished sufficient corroboration of what I then advocated.

Irrigation has had its ups and downs in Alberta, but it is a safe assumption that the "ups" occurred with men who knew the game, and the "downs" with those who did not,—this aside from whatever popular conception or misconception might exist in the rest of the province in regard to irrigation farming.

*An address before the Alberta Branch of the C.S.T.A., January, 1923.

I spoke at the outset of the two main ideas I brought with me from Nevada in regard to Irrigation. I have the evidence of leading C.P.R. officials to confirm these beliefs, and in this light I would like to submit two ideas for your consideration:

(a) It would be an ideal condition if, upon our new irrigation projects we could install experienced irrigation farmers. However, immigration officials tell us that the truly successful irrigation farmer is the hardest kind of a farmer to move, and that only a limited number can be induced to migrate.

(b) Since the settlement of our irrigation projects depends mostly upon farmers comparatively inexperienced in irrigation work it is obvious that very definite and specific technical assistance must be given by men trained for that very purpose; agricultural agents, if you please, but agents of a very specific type. The irrigation projects will also offer openings in practical farming for the young college man who is definitely trained in irrigation farming. Both these conditions lead to the main announcement I wish to make.

We have, at the University, at the present time under consideration, the establishment of a comprehensive course in agriculture that will offer an opportunity of majoring during the last two years of the course, in work that is particularly irrigation agriculture. A committee of our Faculty has been appointed to work out the details of this course, and I may say that nothing will be decided until technical advice is obtained from men who not only have had years of experience in irrigation farming, but have also had experience in institutions where such educational work is carried on. It is obvious that not only will this work embrace a training in agriculture, but also a training in at least some features of agricultural engineering. Frankly I am somewhat sceptical of the possibility of the mature farmer who has had no irrigation experience ever be-

ning an expert irrigationist. It is spoken as almost axiomatic in irrigation countries t it takes practically a generation to de- ope a real irrigation farmer. My own ob- vations tend to confirm me in this belief, d I feel that we would be well advised "to ke haste slowly."

I may say that I have submitted this committee, just mentioned, the ssibility of establishing a six years' irse in combined Agriculture and Engineer- , specializing in the last two years in field rk upon some irrigation project. It is ain that such a course would attract only ughtful and ambitious young men, and uld turn out a high-class student. How- er as I said, the matter is not settled yet. may be added that this matter has been der consideration for some time past, but r certain reasons, not necessary to enumer- here, it did not seem practicable to get ngs in motion. However, the Survey ard for Southern Alberta reported in fav- r of scholarships being granted to Alberta idents to enable them to attend some in- stitution in the United States, and exception was taken to this at the Irrigation Convention last year on the ground that with proper encouragement our own provincial institutions could handle this matter. In anticipation of this very contingency I had been instrumental in securing for our Professor of Soils a man who was born and trained in an irrigation country. Also, it may be added that if we find it necessary to add to our staff further trained experts to meet the need I shall not hesitate to recommend such action to our President and Board. Given a necessary backing we can provide the training without sending our boys away, but we would like to have the co-operation of the different irrigation projects in offering employment to these students-in-training during the summer months.

In conclusion I wish to repeat that for some years I have been deeply interested in irrigation farming, and that anything our College of Agriculture at the University can do to turn out trained men for this work we will be glad to offer as a contribution to the cause of good farming.

Concerning the C.S.T.A.

CONVENTION NOTES

The Dominion Department of Agriculture s again given financial assistance to the nvention by promising to pay the expenses a series of advanced lectures, having par- ular reference to Forage Crops, Soils and conomics. Arrangements are now being ade to secure several prominent lecturers d it is hoped that a fairly definite an- uncement of the Convention programme n be made in the next issue.

Remember the date and place of the Con- ntion—June 20th to 23rd, University of skatchewan, Saskatoon.

NOTES.

J. L. Albert (Laval, 1915) has been trans- rred from the Experimental Station at Ste. nne de la Pocatiere, P.Q., to the Experi- ental Station at Kapuskasing, Ont.

J. E. Shoemaker (O.A.C. '21) is now with the H. J. Heinz Company at Vassar, Michigan.

W. M. Jones (O.A.C. '18) is at present in England in connection with the work of the Soldier Settlement Board.

Professor A. Leitch of the Ontario Agricultural College and Professor H. Barton of Macdonald College, recently gave evidence before the special Agricultural Committee in the House of Commons, Ottawa.

BRITISH COLUMBIA BRANCH

The Annual Convention of this branch was held in Vancouver on March 22 and 23. At the time of writing no report of the meetings has been received, but judging from the very extensive programme that has been arranged it must have been entirely successful.

EASTERN ONTARIO BRANCH

An excellent meeting was held at the Chateau Laurier, Ottawa, on the afternoon and evening of March 19th. At the afternoon session a series of papers were read, or addresses given, on "Recent Developments in Plant and Animal Breeding," by Professor H. Barton, W. T. Macoun, L. H. Newman and A. G. Taylor. The latest information regarding the outbreak of the European Corn Borer in Ontario was given by L. S. McLaine and H. G. Crawford of the Dominion Entomological Branch.

Dr. E. A. Watson gave an excellent paper on "Animal Pathology in Relation to Agriculture and Public Health," which will appear in an early issue of *Scientific Agriculture.*

At the evening banquet about sixty-five members were present. Addresses were given by Dr. J. H. Grisdale on "Some Influences Affecting the Development of Canadian Agriculture" and by Dr. F. C. Harrison on "The Future of Post Graduate Courses at Canadian Institutions."

WESTERN ONTARIO BRANCH

An important meeting of this local is now being arranged and will be held at the Ontario Agricultural College, on April 27th. Members will be duly notified by the local secretary as soon as the programme has been completed, and a report of the meeting will appear in the next issue of this magazine.

FRENCH BRANCHES

Meetings of both the Montreal and Quebec Branches were held during the month of March, the former on the 17th and the latter on the 13th. At each meeting the official organ of the Society was freely discussed and considerable criticism was made. It is apparently the feeling of a number of the French members that a great deal of re-organization is necessary in order that the French members may receive full benefit from the Society and from the magazine, and the possibility of making suitable provision to meet their wishes will have to be considered at the Annual Convention in June.

At the meeting in Quebec City on March 13th, which the General Secretary attended, an arrangement was made whereby the Secretary of the local branch would be res sible for collecting articles suitable for lication in the French pages of the maga

The General Secretary received no n of the meeting held in Montreal on the and was not present. Various reports reached him which varied in their na Another meeting will be held in Apri which the whole question of the relation of the French members to the parent So will be fully discussed and definite re mendations made for the consideration o June Convention.

In order that all the French members be kept fully informed of any developm that may take place, a full report wil published in the next issue.

APPLICATIONS FOR MEMBERSHI

J. H. Bredin, (Saskatchewan, 1922, B.S Regina, Sask.

G. F. H. Buckley, (Alberta, 1920, B.S Edmonton, Alta.

S. M. Denison, (McGill, 1921, B.S.A.) D son's Mills, P.Q.

E. E. Eisenhauer, (Saskatchewan, 1 B.S.A.) Raymond, Alta.

D. G. Fidlar (Toronto, 1922, B.S.A.) sart, Sask.

W. L. Gordon, (McGill, 1922, B.S.A.) donald College, P.Q.

F. S. Grisdale, (McGill, 1911, B.S.A.) Alta.

W. F. Hanna, (Dalhousie, 1915, B.A.; A ta, 1922, B.S.A.) Edmonton, Alta.

J. C. Hooper, (Queen's, 1909, M.A.) Cl holm, Alta.

E. S. Hopkins, (Toronto, 1911, B.S.A.) tawa, Ont.

C. D. Jarvis, (Toronto, 1899, B.S.A.; nell, 1909, Ph.D.) Grimsby, Ont.

G. A. Jones, (Manitoba, 1913, B.S.A.) St more, Alta.

A. T. Kemp, (Alberta, 1922, B.S.A.) Alta.

P. C. Kidd, Regina, Sask. (Associate m ber).

A. R. Milne, (McGill, 1921, B.S.A.) Catherines, Ont.

W. J. Riley, (British Columbia, 1922, B.S Vancouver, B.C.

Geo. Wilson (Toronto, 1913, B.S.A.) Catherines, Ont.

Co-operative Experiments with Copper Carbonate Dust and Other Substances for Smut Control.

W. P. FRASER and P. M. SIMMONDS,

Dominion Laboratory of Plant Pathology at the University of Saskatchewan.

Copper carbonate dust was first tried in New South Wales for the control of smut. Darnell-Smith (1) in 1917 reported on experiments conducted in 1915 and 1916 with dry copper carbonate, used at the rate of two ounces per bushel. This gave better results in the control of bunt of wheat than the standard method used in Australia, i.e., bluestone solution and lime. In 1919 a more full report (2) was made on experiments carried out in 1918 and 1919; the results showed that copper carbonate controlled bunt of wheat perfectly when a dusting machine was used. With hand treatment a small amount of smut was present. No injury was caused to the seed and the yield was much increased over plots treated with the wet treatment by copper sulphate and lime. Perkins (3) defended the bluestone method of treatment and questioned that copper carbonate "a substance wholly insoluble in water can have high fungicidal powers." A reply (4) to this criticism was published in 1921. Satisfactory control of bunt in wheat was obtained by Mackie and Griggs (5) in row experiments carried out in California in 1921. Lambert and Bailey (6) have the result of experiments carried out in spring wheat in Minnesota. They found copper carbonate dust gave perfect control, both of bunt of wheat and oat smut. Heald and Smith (7) found copper carbonate dust controlled bunt and increased the percentage of germination. They report (8) on the results of more extensive experiments with both spring and winter wheat in 1922. It was found that two ounces of copper carbonate dust per bushel gave effective control of bunt of wheat. Coons (9) reports on experiments carried out in Michigan and from his results concludes that with fairly clean grain copper carbonate dust or copper sulphate and lime would give satisfactory control of sinking smut. Tests with oats were not satisfactory.

The wet formaldehyde treatment is generally used to control smut in the wheat growing districts of Western Canada, and has usually given satisfaction. There have been few reports of seed injury. It was thought, however, advisable to test out the dusting methods, which have certain advantages over the wet treatments.

Preliminary experiments were begun in 1921 with copper sulphate and lime (see Division of Botany Report for the year ending 1922). More extensive experiments were undertaken in 1922 in co-operation with the Dominion Experimental Farms at Indian Head, Scott and Rosthern in Saskatchewan, and Lacombe in Alberta. This generous co-operation made possible a number of experiments and thus made the results of much greater value. These co-operative experiments were planned so as to make them agree with the outline of the cereal treatment project prepared by the Crop Protection Institute.

A mixture of copper sulphate and lime as well as copper carbonate dust was tested in comparison with the ordinary formalin treatment. The mixture of copper carbonate and lime was prepared and supplied by Mr. Arthur Kelsall of the Dominion Entomological Laboratory at Annapolis Royal, N.S. All the seed was treated at the Dominion Laboratory of Plant Pathology at Saskatoon, and forwarded to the various stations. Seeding and other operations including harvesting and threshing were done by the Experiment Stations. The estimate of smut percentage in the plots was made by a member of the Dominion Laboratory of Plant Pathology at Saskatoon.

At outline of the experiments follows, and the results in tabular form (Table No. 1 and No. 2).

Outline of Experiments

Seed. Marquis wheat, badly smutted, obtained from the grain inspector at Fort William, Ontario, and Winnipeg, Manitoba. The seed used at Indian Head Experimental Farm was Marquis Wheat, heavily smutted artificially.

Oats (Banner) smutted artificially.

Treatment and Method:

No. 1. Formaldehyde solution, 1 to 320; seed dipped five minutes and then covered one hour. Formaldehyde was tested by Professor Thorvaldson of the Department of Chemistry, University of Saskatchewan, and the solution was made up to proper strength.

No. 2. Copper carbonate dust. The commercial form of copper carbonate in which the copper is all present in that form; the material also contains calcium and other impurities. This was used at the rate of two ounces per bushel and shaken thoroughly hand in a container with the seed.

No. 3. Dehydrated copper sulphate d and hydrated lime, 15% metallic copp (.43 lbs. dehydrated copper sulphate .57 l hydrated lime). Also used at the rate two ounces per bushel.

No. 4. Check. No treatment.

Germination Tests. 100 seeds were tes in each treatment for each station, in sa and soil in the greenhouse and in plates w blotting paper.

Size of the Plots. All the plots w 1-40th of an acre, seeded in duplicate, exc at Rosthern and Indian Head Domini Laboratory, where only one plot was us for each treatment.

Moisture. The moisture content of t soil at planting time at all these stations w abundant.

TABLE NO. 1.

Experiments in Seed Treatment for Control of Bunt of Wheat and Smut of Oats.

Station.	Treatment.	Germination % Soil	Sand	Plates	Average	Date seeded.	Date harvested	% Smut Present.	Yie per ac in bu
	WHEAT (Marquis)								
	Formaldehyde	86	96	97	93	May 19	Aug. 28	0	53.33
INDIAN HEAD	Copper carbonate dust	90		94	92	"	"	.4	54.
Exp. Farm	Copper sulphate and lime	94	98	97	96.3	"	"	.7	58.66
	No treatment (check)	96	90	98	94.6	"	"	5.5	53.66
	Formaldehyde	67	90	81	79.3	May 1	Aug. 31	0	26.33
LACOMBE	Copper carbonate dust	100	82	99	93.2	"	"	.6	25.33
Exp. Farm	Copper sulphate and lime	91	90	99	93.3	"	"	2.2	25.33
	No treatment (check)	98	100	99	99	"	"	16.9	25.33
	Formaldehyde	82	94	98	91.3	May 8	Aug. 31	0	39.33
ROSTHERN	Copper carbonate dust	98	100	99	99.	"	"	1.33	39.33
Exp. Farm	Copper sulphate and lime	98	96	97	97.	"	"	5.	38.66
	No treatment (check)	100	98	96	98.	"	"	17.7	34.66
	Formaldehyde	67	90	81	79.3	May 18	Aug. 21	0	16.33
SCOTT	Copper carbonate dust	100	82	99	93.6	"	"	0	17.33
Exp. Farm	Copper sulphate and lime	91	90	99	93.3	"	"	tr.	16.56
	No treatment (check)	100	100	99	99.6	"	"	5.4	18.16
	Formaldehyde	74	96	43	71.	May 19	—	0	—
INDIAN HEAD	Copper carbonate dust	90	86	94	90.	"	—	1.	—
Dom. Lab.	Copper sulphate and lime	94	94	96	94.6	"	—	2.	—
	Check (no treatment)	90	90	96	92.	"	—	15.8	—
	OATS (Banner)								
	Formaldehyde	94	94	93	93.6	—	—	0	—
INDIAN HEAD	Copper carbonate dust	96	100	94	96.6	—	—	1.	—
Dom. Lab.	Copper sulphate and lime	100	100	93	97.6	—	—	5.6	—
	No treatment (check)	86	100	100	95.3	—	—	7.5	—

TABLE NO. 2.

verages Table No. 1 For All The Stations, Indian Head, Lacombe, Rosthern, Scott, and Indian Head Dominion Laboratory.

WHEAT (Marquis)

Treatment.	Average percentage germination.	Average percentage Smut present.	Average Yield per acre in bushels.
Formaldehyde	82.78	0	33.83
Copper carbonate dust	93.56	.65	33.99
Copper sulphate and lime	94.90	1.98	34.87
No treatment (check)	96.64	12.26	32.96

Estimate of Smut. The amount of smut resent was estimated by selecting 100 heads om five different places in each plot, chosen random, and the percentage based on the nount of smutted heads present in the 500 us selected. In the formaldehyde treatment e whole plots were examined carefully and trace of smut found.

Smut Present. In the wheat experiments e smut present was mostly *Tilletia tritici* Bjerk.) Wint. and a small amount of *T. vis* Kühn. In the oat experiments it was *stilago levis* (K. & S.) Magn.

Yield. The yield is given in bushels and e decimal of a bushel per acre.

It will be seen from the results that in all e experiments the formaldehyde solution ve perfect control. Copper carbonate st was effective where the percentage of nut was low. Copper sulphate and lime is not so effective.

Both in the field and in the germination ts in the greenhouse, formaldehyde mark-ly retarded growth. The percentage of rmination averaged about 10% higher with pper carbonate dust than with formalde-de. The yields are too close to be signi-ant.

It was found in the experiments in New uth Wales that when a machine was used r dusting with the copper carbonate dust e grain was free from smut, while hand eated seed showed a small amount. may be that machine treatment would have ven better results in the experiments de-ribed. The seed was however shaken oroughly in the hand treatment.

It seems advisable to test out dusting with copper carbonate another year, as the dusting method has many advantages over the wet method. The grain can be treated in advance of seeding without injury, and there is no seed injury or retarded growth. The wetting of the seed and danger to germination by freezing before seeding is also eliminated and there is less danger of reinfection from smutty sacks, etc. On the other hand the cost of the materials for treatment is increased. The materials for copper carbonate treatment would cost at least about two to three cents per bushel of seed, the formaldehyde less than a cent per bushel at present prices. The cost of labour would however probably be less in the dust treatment.

Experiments with Seed-o-San, Chlorophol, Gas Treatment.

A request from a firm in the United States to test Seed-O-San, a dust for seed treatment, and Chlorophol, a substance to be used in solution, was complied with. Both of these substances were tested for the control of smut. A gas treatment for smut control by the "Gas Grain Pickler' method was tested last year, (See Division of Botany Report, page 63, 1922) and found unsatisfactory. A further test was made this year. The results of these experiments are given in Table No. 3, including the results of germination tests of the treated seed. The seed used, germination tests, size of plots etc., were similar to those described in the outline of the experiments the results of which are given in Table No. 1.

TABLE NO. 3

Experiments in Seed Treatment for Control of Bunt in Wheat.

Station	Treatment	Germination % Soil	Sand	Plates	Average %	Date Seeded	Date Harvested	% Smut Present	Y per
INDIAN HEAD Exp. Farm	Seed-O-San	90	80	96	88.66	May 19	Aug. 28	3.1	60
	Chlorophol	96	98	97	97.	"	"	1.8	61
	No treatment (check)	96	90	98	94.6	"	"	5.5	53
ROSTHERN Exp. Farm	Seed-O-San	96	98	98	97.33	May 8	Aug. 31	6.83	35
	No treatment (check)	100	98	97	98.33	"	"	17.7	34.
SCOTT Exp. Farm	Gas treatment	87		90	88.6	May 18	Aug. 21	3.	16
	No treatment (check)	98	100	99	99.	"	"	5.4	18.
INDIAN HEAD Dom. Lab.	Seed-O-San	92	86	90	89.33	May 19	Aug. 25	4.8	—
	Chlorophol	94	88	96	93.	"	"	3.6	—
	Gas treatment	75	88	94	85.6	"	"	11.3	—
	No treatment (check)	90	90	96	92.	"	"	15.8	—

It will be seen from the results that Seed-O-San and Chlorophol were not very effective in controlling smut. The gas treatment was very unsatisfactory. (It may be added that chlorophol has given satisfactory results in experiments reported by Heald & Smith) (8).

Experiments with Mixtures of Copper Carbonate Dust, Sulphur, and Other Substances

Further tests were made with copper carbonate mixed with various substances, as infusorial earth, talc, etc. If the mixtures were found effective the addition of these substances would reduce the cost.

All these mixtures were also prepared and supplied by Mr. Arthur Kelsall of the Dominion Entomological Laboratory at Annapolis Royal, N.S., who furnished the following information. They were all made up so that they contained 15% of metallic copper. The copper carbonate used was the commercial product mentioned previously. The following is a list of mixtures used:—

Copper carbonate (com.) and hydrated lime; 15% metallic copper, .75 lbs. copper carb., .25 lbs. hydrated lime.

Copper carbonate (com.) and infusorial earth; 15% metallic copper, .75 lbs. copper carb., .25 lbs. inf. earth.

Copper carbonate (com.) and talc, 15% metallic copper, .75 lbs. copper carb., .25 lbs. talc.

Dehydrated copper sulphate and infusorial earth; 15% metallic copper, .43 lbs. dehyd. copper sulph., .57 lbs. infus. earth.

Dehydrated copper sulphate and talc; 1 metallic copper, .43 lbs. dehydrated cop sulphate, .57 lbs. talc.

In addition to these mixtures of cop dust a number of other substances were t ed.

The sulphur used was superfine, 9 passing through a 200 mesh to the i screen. These experiments were carried at the Dominion Laboratory of Plant P ology at the Experimental Farm, Ind Head. The seed used, size of plots, etc., w the same as in the experiment already cribed, but the plots were single, not duplicate.

The results of these experiments are gi in Table No. 4. It will be seen the mixtures were not as efficient as c per carbonate dust alone. Sulphur redu the amount of smut and owing to its che ness seems worthy of further trial.

Seed Treatment of Liberty Oats.

As formaldehyde solution injures seric ly the germination of hulless oats (Liber even with the troublesome presoak meth a number of dusts and other substances w tested for smut prevention, hoping to f effective control without seed injury. A of experiments was carried out at Lacon in co-operation with F. H. Reed, Superint dent of the Experimental Farm, and at the pl of the Dominion Laboratory at Indian He The seed used was heavily smutted artifici ly. The method of treatment, size of pl

TABLE NO. 4

Experiments in Seed Treatment for Control of Bunt of Wheat and Oat Smut at Dominion Laboratory plots, Indian Head.

WHEAT

Treatment	Average Germination %	Date Seeded	Percentage of Smut Present
Formaldehyde solution	70	May 19	0
Copper carbonate and lime	90.3	"	3.1
Copper carbonate and infusorial earth	93.66	"	1.6
Copper carbonate and talc	96.	"	2.5
Copper sulphate	91.66	"	.8
Copper sulphate and infusorial earth	87.	"	1.3
Copper sulphate and talc	90.33	"	1.0
Bordeaux mixture dust	96.	"	3.3
Magnesium Bordeaux dust	89.	"	2.3
Sulphur dust (bacterized)	90.66	"	9.1
Nickel carbonate dust	90.66	"	3.3
Sulphur dust	90.66	"	3.5
Sulphur dust	91.	"	2.5
Check	88.	"	15.8
OATS (Banner)			
Formaldehyde solution	93.66	"	0
Copper carbonate	96.66	"	1
Copper carbonate and talc	98.66	"	6.3
Copper carbonate and lime	97.66	"	5.6
Copper carbonate and infusorial earth	98.33	"	6.9
Seed-O-San	99.66	"	7.9
No treatment (check)	95.33	"	7.5

tc., were the same as in the previous experiments. At Lacombe the plots were in duplicate, at Indian Head only single plots were sed.

It will be noticed that though the germination of the hulless oats was severely injured by the ordinary formaldehyde treatment, yet at Lacombe the grain on this plot ooled freely, and was much later of maturing than in the other plots. Nevertheless the yield was greater. This result was probably exceptional, and due to a season favourable to the maturity of late grain. Copper carbonate dust treatment gave no seed injury, and fairly effective control. It seems probable that if the seed was not heavily smutted, dusting with copper carbonate would prove effective in controlling smut in

TABLE NO. 5

Experiments in Seed Treatment for Control of Smut of Liberty Oats.

Station	Treatment	Germination % Soil	Sand	Plates	Average %	Date Seeded	Date Harvested	% Smut Present	Yield per Acre lbs.
INDIAN HEAD Dom. Lab.	Formaldehyde	4	24	82	36.66	May 19	—	0.	—
	Chlorophol	64	86	85	78.33	"	—	39.6	—
	Copper carbonate	52	88	94	78.	"	—	1.	—
	Copper sulphate and lime	94	92	97	94.33	"	—	4.9	—
	Copper sulphate and infus. earth	60	90	89	79.	"	—	3.5	—
	Seed-O-San	78	84	98	86.66	"	—	37.1	—
	No treatment (check)	68	66	99	77.66	"	—	60.8	—
LACOMBE Exp. Farm	Formaldehyde	19	16	44	26.33	May 2	Aug. 22	0.	1260
	Pre-soak formaldehyde	20	60	79	53.	"	12	1.5	1040
	Copper carbonate	52	88	89	76.33	"	11	10.	960
	Copper sulphate and lime	71	76	85	77.33	"	11	20.	780
	No treatment (check)	32	62	95	63.	"	12	93.	420

Liberty Oats without seed injury. The other dust treatments were not satisfactory.

Discussion and Summary.

The results of these experiments show that copper carbonate is the most effective of the dusts tested for smut control. Mixtures of copper carbonate with substances such as Fullers' earth, lime, etc., reduce its effectiveness. No seed injury resulted from the use of copper carbonate. The formaldehyde treatment by dipping retarded and reduced germination of wheat but was not serious enough to be reflected in the yield of the plots. It gave perfect control of smut.

Where seed is not heavily infected with smut copper carbonate used as a dust will control smut, and may be recommended. With heavily infected seed formaldehyde treatment will give better results. Where formaldehyde treatment is generally used it does not seem advisable to recommend a change to dust treatment until this method is fully tested. While under certain conditions seed injury may result, yet this is not usually serious enough to affect the yield.

The advantages in dust treatment have already been pointed out. It has been shown by Heald & Smith (8) that seed can be treated some time in advance of seeding without danger of injury to germination. This cannot be done with the formalin treatment as serious seed injury may result.

The dust should be thoroughly mixed with the seed grain; a revolving churn might be used or a machine such as that described by Heald and Smith could easily be constructed. The effectiveness of the treatment depends to a great extent on thorough dusting of the seed. A respirator may be used to prevent inhalation of the dust. That made by the Wilson Goggles Company of Reading, Pa., has been reported as satisfactory in California.

The gas treatment in which paraformaldehyde is heated and the gas is pumped into a wagon box of wheat is unsatisfactory. The vapour condenses on the wheat near the openings for the gas and is not distributed. The presence of this paraformaldehyde is injurious to the germination of the seed. This was shown by growing the treated wheat in pots in the greenhouse. This might be expected as it has been shown by H Hurd(10) that the injury from drying of after wet formaldehyde treatment is du the deposit of paraformaldehyde on the when the liquid evaporates.

(Acknowledgements are made of the crous co-operation of the Superintendent the Dominion Experimental Farms, W Munro, Rosthern; M. J. Tinline, Scott; F Reed, Lacombe; and N. D. McKenzie of dian Head. Without their co-operation experiments would have been impossi Special acknowledgements are due N. D. Kenzie of Indian Head who provided the bour for the plots of the Dominion Lab tory of Plant Pathology at the Indian H Farm.)

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Experiments on the Dust Method of Smut Control.

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Introduction.

The following is a brief account of certain experiments conducted by various members, past and present, of the Annapolis Entomological Laboratory together with co-operative help from Professor W. S. Blair, relating to the control of smut by seed treatments with various dusts. The experimenters did not have primarily in mind the working out of any practical procedure for the control of smut by means of dusts, but being interested at the time in the manufacture of several insecticide-fungicide dusts in which copper and other elements were present in different forms, and possessing a fair knowledge of the insecticidal properties of the aforementioned dusts and desiring further information on the fungicidal properties of them, the following was one of the methods seized upon to determine the relative fungicidal value of copper in the form of different compounds and also as compared with various other elements. The possibility that the experiments might show practical economic results was, however, kept in view, but this object was regarded as secondary to that already stated. The above explanation is necessary in order that the planning of the experiments and the use of certain materials may be understood. However the experiments yielded results which may be of practical value and they are therefore presented in order that results may be utilized, and in the hope that the data as a whole may prove of value to future workers searching for the most efficient and cheapest method of controlling smut by means of seed dust treatment.

The dust method of seed treatment possesses certain definite advantages. The method is simple and speedy, treated grain may be stored indefinitely, there is no swelling of the grain, apparently no injury to seed germination, and the method should be a cheap one. These advantages, assuming the method are regarded as sufficiently efficient or capable of being made so, are fairly obvious and need no further elaboration.

Experiments in 1921.

For the experimental work of this year, three grain varieties were utilized, namely, Liberty oats, Victory oats, and Huron wheat. The Victory oats however developed practically no smut, and the Huron wheat was lightly infested only with loose smut which would not in any case be amenable to such treatment, and consequently these two grains will not be referred to again. The Liberty oats were however heavily infested with smut.

In all cases the seed was weighed, placed in a pile, the dust sifted on top of the pile, and the grain then turned over several times and bagged. Five ounces of dust were, in this experiment, used to every twenty pounds of grain.

The following are the materials used on the various plots:—

Plot 1. The seed was treated with a modified wet formalin method, the usual formalin procedure not being followed as it was known to injure seriously the germination of this particular variety. The grain was soaked in water for ten minutes and partly dried after which it was soaked in formalin solution, one pint to forty gallons, for three minutes. The seed was then taken out, partly dried, and sown immediately.

Plot 2. The seed on this plot had no treatment.

Plot 3. The dust used was composed of 28.5% dehydrated copper sulphate and 71.5% infusorial earth. The latter was used purely as an inert filler leaving the copper sulphate entirely water soluble. This dust thus contained 10% metallic copper.

Plot 4. The dust was composed of 28.5% dehydrated copper sulphate and 71.5% hydrated lime. On contact with water this mixture forms a Bordeaux, the copper thus being insoluble in water but nevertheless fairly soluble in acids or organic solvents. This dust also contained 10% metallic copper.

Plot 5. The dust used was made in the following manner:—53 parts of stone lime were slaked with a small amount of water and while slaking 40 parts of crystal copper sulphate were added, the whole being then thoroughly mixed and ground. The copper in this dust was in the form of the oxide, or a brown hydrated oxide, and consequently insoluble in water, and less readily soluble in other solvents than the dust of the previous plot. The dust made in the above manner contained 10% metallic copper.

Plot 6. The dust used was composed of 10% dehydrated copper sulphate, 5% calcium arsenate, and 85% hydrated lime being the dust in general use at that time for treating orchards. This dust contained only 3.5% metallic copper.

Plot 7. This dust was the same as that used in plot 4. In this case the grain was moistened with water before applying the dust.

It will be noted that in plots 3, 4, and 5, the dusts in each case contained 10% metallic copper but that the copper was present in different forms.

As the season progressed it was evident that wide variations existed in the severity of smut infestation between the various plots, though the infestation within each plot was very uniform and in no case showed any evidence of being patchy. The germination of seed did not appear to be injured in any plot. The results were taken by a count of about 500 heads in each plot, counts being taken from sheaves cut at different points on each plot.

Table 1.

SMUT CONTROL, 1921, LIBERTY OATS.

Plot	Treatment	% Smut Present
1.	Modified formalin treatment	52.1
2.	No treatment	61.3
3.	Dehydrated copper sulphate and infusorial earth	2.5
4.	Dehydrated copper sulphate and hydrated lime	16.2
5.	Copper oxide (or hydrated oxide) and hydrated lime	45.3
6.	Bordeaux dust (ordinary orchard dust)	72.9
7.	Seed moistened with water, dusted same as plot 4	9.5

Discussion

Several interesting points are to be not from a perusal of the above table. T water soluble copper sulphate (plot 3.) more efficient than the same amount of co per in the form of Bordeaux mixture (pl 4), and this again is much more efficie than copper in the form of oxide (p 5). Sprinkling the grain with water p paratory to dusting increased the efficiency the treatment (comparison of plots 4 and 7 The ordinary orchard Bordeaux dust w not effective; it either contained too litt copper, too much lime, or the arsenic inte fered. The failure of the modified formal treatment must not of course be taken casting any doubt upon the well proven a highly effective regular formalin treatme but must merely be regarded as the failure this particular modification. Although co siderable information may be obtained fro the above experimental data yet the on material promising for practical purpos is that used in Plot 3.

Experiments in 1922

For the experimental work of this ye Liberty oats were again used. In this ca all the seed grain was placed in a large pi and vigorously turned over with shovels se eral times in order to obtain a uniformly i fested seed. From this pile samples we weighed out and placed in a small churn a the particular dust added, the churn revolve for a few minutes, and the treated grain ta en out and bagged. In this experiment a seed was treated at the rate of 4 ounces dust per 1 bushel of grain. The plots we all one-thirtieth of an acre in area, all plo were seeded on the same day and likewis harvested at the same time.

The following are the materials used on t various plots:—

Series A. Dehydrated copper sulpha with different fillers and at different strength

On plots 1 to 5 inclusive were used dus containing in all cases 43% dehydrated co per sulphate, or in other words 15% me allic copper. The remaining ingredien were fillers of various types.

On plots 6 to 9 inclusive were used dus composed in all cases of mixtures of deh drated copper sulphate and infusorial ear in various proportions.

Plot 1.	Dehydrated copper sulphate 43%,	infusorial earth 57%.
Plot 2.	" " " "	calcium carbonate 57%
Plot 3.	" " " "	gypsum 57%
Plot 4.	" " " "	talc 57%
Plot 5.	" " " "	hydrated lime 57%

Plot 6.	Dehydrated copper sulphate 14%,	infusorial earth 86%	(5% Cu)
Plot 7.	" " " 29%	" " 71%	(10% Cu)
Plot 8.	" " " 57%	" " 43%	(20% Cu)
Plot 9.	" " " 86%	" " 14%	(30% Cu)
Plot 10.	No treatment.		

Series B. Pure Chemicals.

Plot 11. Dehydrated copper sulphate; the commercial salt but practically pure.

Plot 12. Copper carbonate; the chemically pure green carbonate $Cu_2 (OH)_2 CO_3$.

Plot 13. Copper oxide; - c.p.

Plot 14. Copper sulphide: - c.p.

Plot 15. Copper arsenate; - c.p.

Plot 16. Copper arsenite; - c.p.

Plot 17. Dehydrated aluminium sulphate; this material was made from the crystalline sulphate by subjecting to low heat and grinding; a commercial grade containing a small amount of iron.

Plot 18. Dehydrated nickel sulphate; also prepared as above from the crystalline sulphate; a commercial grade.

Plot 19. Dehydrated cobalt sulphate; also prepared as above from the crystalline sulphate; a commercial grade.

Plot 20. No treatment.

Series C. Miscellaneous Dusts.

Plot 21. A dust composed of 50% dehydrated copper sulphate and 50% tobacco dust.

Plot 22. Copper carbonate; - a commercial grade containing about 25% Cu.

Plot 23. Prepared Bordeaux; - a commercial grade containing about 12% Cu.

Plot 24. Sulphur dust; - the superfine material in general use for dusting orchards.

Plot 25. Inoculated sulphur dust; - this sulphur, which contained a small amount of organic matter, was stated by the manufacturers to have been inoculated with certain bacteria which promote the formation of sulphur di-oxide. There was quite a high percentage of coarse particles in this material.

As far as could be seen by the eye no injury to seed germination occurred on any of the above plots. Differences between plots were very marked, but the severity of smut infestation in the stand of each plot seemed very uniform. The results were taken by a count of between 500 and 1500 heads in each plot, counts being taken from sheaves cut at different points on each plot.

DISCUSSION.

From a brief consideration of the above table several broad generalizations are apparent.

(1) Smut was partially controlled by dust seed treatment with a large range of materials.

(2) Under the conditions of this experiment smut control was in no case perfect.

(3) Control of smut closely approached perfection in the case of various copper compounds and of elemental sulphur.

It will be noted that the most effective material used was copper arsenite, the effectiveness of the succeeding copper compounds being in the following order, copper carbonate, copper sulphide, dehydrated copper sulphate, copper arsenate, and copper oxide. Speaking generally it would appear, from a consideration of plots 1 to 11, that it would be inadvisable to attempt diluting copper compounds with other inert materials, although an exception will be noted in plot 4 where copper sulphate and talc was used and where indeed the talc may have served a useful purpose in assisting in the adherence of the materials. Copper arsenite is, of cour a highly poisonous material and its un stricted use might be considered unwise less subsequent experiments show it to much superior to other non-poisonous m terials, but it is interesting to note that t well known material Paris green, a ve similar compound, would probably act in t same way. Of the copper compounds, the copper carbonate, copper sulphide, and hydrated copper sulphate, are promising m terials.

The sulphur dust plots 24 and 25 are considerable interest. Smut control was fa

SMUT CONTROL, 1922, LIBERTY OATS

Series	Plot	Treatment	% Smut Present
A	1.	Dehydrated copper sulphate and infusorial earth (10% Cu)	4.8
	2.	Dehydrated copper sulphate and calcium carbonate (10% Cu)	5.4
	3.	Dehydrated copper sulphate and gypsum (10% Cu)	7.6
	4.	Dehydrated copper sulphate and talc (10% Cu)	2.0
	5.	Dehydrated copper sulphate and dydrated lime (10% Cu)	7.0
	6.	Dehydrated copper sulphate and infusorial earth (5% Cu)	18.3
	7.	" " " " " (10% Cu)	7.1
	8.	" " " " " (20% Cu)	3.4
	9.	" " " " " (30% Cu)	3.3
	10.	No treatment	46.4
B	11.	Dehydrated copper sulphate	2.9
	12.	Copper carbonate (c. p.)	1.5
	13.	Copper oxide (c.p.)	24.1
	14.	Copper sulphide (c.p.)	1.9
	15.	Copper arsenate (c. p.)	3.4
	16.	Copper arsenite (c. p.)	1.0
	17.	Dehydrated aluminium sulphate	17.7
	18.	Dehydrated nickel sulphate	3.6
	19.	Dehydrated cobalt sulphate	4.9
	20.	No treatment	33.6
C	21.	Dehydrated copper sulphate and tobacco	6.8
	22.	Copper carbonate	1.1
	23.	Prepared Bordeaux	8.5
	24.	Sulphur Dust	3.5
	25.	Inoculated sulphur dust	2.8
	26.	No treatment	46.4

effective from these sulphur treatments, ough not quite as effective as from the bove mentioned copper compounds, but the lphur is effective enough to be worthy of uch consideration due to the cheapness of e material. Since these experiments were erformed examinations have been made of ain dusted with sulphur at different rates. n examination of individual seeds taken om grain dusted at the rate of four ounces the bushel, as was done in the preceding xperiment, showed the dust particles to be aced on the grain a considerable distance part and the grain was by no means cover- l with a sulphur dust film. Using sulphur increased rates remedied this matter very reatly, so much so that it is felt that an in- ease in the amount of sulphur used could ot help but increase the effectiveness of the eatment.

The inoculated sulphur dust gave some- hat better results than the ordinary sulphur. his might be considered within the experi- ental error but as previously pointed out e inoculated sulphur was much coarser than e other, and this leads one to suppose that e inoculated sulphur may be superior. The atter is at least worthy of further trial.

CONCLUSIONS.

As far as conclusions may be drawn from these experiments it would appear inadvisable to use the dust method for the control of smut where an absolute control is desired, but it would seem possible that further work may sufficiently increase the effectiveness of the method. In the very considerable districts where seed treatment is not at present practised, and in the districts where absolute control is not a necessity, the dust method would probably make a greater appeal to the farmer than the formalin treatment. Also for such grain varieties as Liberty oats which are known to be highly susceptible to formalin injury, the dust method could be advantageously used.

Tentatively copper carbonate could be recommended as a suitable material, or sulphur dust (which is more readily available to everybody) could be recommended in somewhat larger amount than used in the above experiment. Copper carbonate used at the rate of four ounces to the bushel would probably cost about six cents for material per bushel treated. Sulphur used at the rate of eight ounces per bushel would probably cost about two cents per bushel treated.

A STUDY IN DISEASE SUSCEPTIBILITY.

The photograph used on the cover of this umber was taken in the Experimental green- ouses of Macdonald College. The plants the bed were being used in a study of to- acco mosaic and all but two were inoculat- l successfully in October, 1922, with mosaic. he usual symptoms appeared as the plants veloped until November 27th, 1922. On at day numerous small spots appeared in veral lower leaves of mosaic-diseased ants. The spots were at first watersoaked d about pin-head size. They rapidly turn- dark brown and eventually became almost hite. In many instances zonation showed d on some leaves the lesions coalesced be- een the larger veins. The disease spread owly as a result of the spraying and splash- g of water from diseased leaves on other aves of mosaic-diseased plants. In spite continued attempts at infection under eal moisture conditions no lesion appear- in any leaf of a healthy plant. It was at st thought to be wildfire from its symptoms, but cultures have given so far only a micrococcus. Further study is being made of the disease by Mr. T. G. Major, M. Sc., Tobacco Pathologist of the Tobacco Division, Central Experimental Farm, Ottawa, in cooperation with the writer.

Several points of interest are to be noted in the photograph. The dwarfing of the mosaic-diseased plant is well shown. The two healthy plants are 2½ ft. taller than the top of the photograph i.e., they are twice as tall as, and with correspondingly larger leaves than, the diseased plants. Their unspotted condition is marked in the two lower leaves showing among the diseased plants. The fact that healthy seedlings are not affected is indicated by the two plot plants in the foreground. Mosaic symptoms can be seen in many of the leaves of affected plants. The photograph is by Mr. H. R. Angell, a plant pathology student of Macdonald College.

B. T. DICKSON.

Raspberry Mosaic and Curl.*

B. T. DICKSON,

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INTRODUCTION.

The writer has been engaged since 1919, in a study of that interesting and economically important group of diseases known generally as "mosaic diseases". During the course of these investigations, his attention was repeatedly drawn to the seriousness of similar diseases of the raspberry. As a result of investigations, which will not be considered here, it was decided that in Quebec the raspberry suffered from a definite "mosaic" and a "leafcurl". These diseases have been present in raspberry plantations in various parts of Canada, and the Northern United States for many years, as is indicated by the literature. Green (1895) in Minnesota described leafcurl, and Stewart (1902) described a disease which he called "yellows" apparently because of certain similarities to peach yellows, and which is undoubtedly mosaic (Rankin, Phytopathology, 12: 254. Melchers (1914) discussed "yellows or curl", terms which he used synonymously. In Dec. 1920 the writer presented evidence in a paper read at Guelph, before the Canadian Branch of the American Phytopathological Society, showing that there were two distinct diseases—a mosaic and a leafcurl. At the same time Rankin arrived at similar conclusions, (Phytopathology, 12 : 253 - 264, 1922) as a result of studies in Ontario. Owing to the use of the general term "yellows" it is now considered advisable to confine the terminology to "mosaic" and "leafcurl," for the present at any rate. It may be stated here that in Quebec very marked yellowing is typical of leafcurl in its advanced stages. Furthermore, there is a peculiar type of mosaic symptom in which the usual marked mottling and blistering do not occur. Instead the leaflets are broad with recurved tips. If mottling is present, it is of a fine speckled type and when mottling is not discernible, or only slightly so, the leaves are somewhat darker green than normal. The petioles are shortened and thus the leaves are sligh crowded. During the summer of 1920 pla were marked which showed these sympto It was thought that possibly hot dry weat might give rise to this type as it does t somewhat similar modification in ordin mosaic. The summer of 1921 was hot a dry and diseased plants developed stunt curved, bronzed and slightly mottled leav but in 1922, with an ample rainfall, symptoms were as in 1920.

Wilcox (U.S.A. Arc. 227, 1922) has d cribed a similar condition in black ra berry which he calls "Eastern blue-ste because of the characteristic discolored sp or stripes on the stems of affected plants. stem discolorations have been observed the red raspberry plants at Macdonald C lege. There is of course the possibility o double infection of leafcurl and mosaic.

MOSAIC.

Symptoms.

The symptoms vary with the time of fection and the weather. Canes which a newly infected in spring or early summ develop new leaves which usually sh much blistering with marked contrast tween the dark green of the blister and t pale yellow-green of the remainder of t leaf blade. The petioles are slender and t leaflets rather spindly and if the dark gre areas are near the midribs, the margins a rolled down and in. Given dry weather t leaves developing later do not show blist ing and rolling, but a speckling and ten ency to shortening of the petioles with broadening of the leaflets. The speckled slightly splotched leaf is the usual sympt in leaves developing as a result of late inf tion, although in rather wet, cooler seaso even the late leaves are blistered and d torted. The next spring suckers exhibit a vanced symptoms—considerable blisteri and distortion with slender, rolled leafle The general appearance of the cane is y

* (A paper given before the Quebec Pomological Society, Dec. 6th, 1922.)

wish green instead of healthy green and s a rule it is somewhat dwarfed. The mount of dwarfing depends upon season, il, etc. and it becomes more pronounced in ucceeding suckers. Dwarfing is typical in url-diseased plants, but whereas in mosaic he canes are spindly, they are short and ocky with curl. Dry hot weather modifies he leaf symptoms in such canes, as above entioned. It is obvious that it is merely matter of time until diseased canes can-ot develop sufficient food supplies to enable em to begin growth in the spring. In the uiting canes diseased laterals tend to be indly and weak although this symptom ay not be pronounced the first or even se-ond year after rather slight infection. If he season is hot, the laterals may be some-hat bushy because of shortened petioles.

There is a distinct tendency for mosaic-iseased plants to flower and set fruit earlier an normal, and in this respect there is a re-arkable similarity to the situation in peach ellows. The first season there is apparently ttle difference in the fruit other than that is somewhat lacking in flavour. During ucceeding seasons the tasteless character is ccentuated and with it goes a reduction in ulp until the berries are useless.

Once a plant is infected it does not recover nd the fact that healthy canes and diseased anes may be found in the same clump should ot affect the grower in deciding on its re-oval.

Varietal Susceptibility.

In Quebec the commonly grown raspberry arieties are susceptible in the order named—uthbert, Marlboro, King, Columbia, New-an 23, Herbert, Newman 1 and Newman 4. Of these the first four named are sus-ptible, Cuthbert and Marlboro markedly , while it is to be noted that other varieties e infected much more heavily if grown in roximity to Cuthberts or Marlboro than if olated. At present it cannot be stated that y variety is resistant. At Ottawa and Gen-a, N.Y., it would appear that St. Regis and unbeam may be the least susceptible.

Spread of the Disease.

All indications at present point to the hid, *Aphis rubiphila*, as the agent in the read of raspberry mosaic. Attempts to spread the disease by pruning have not yet been successful so that it does not appear that pruning itself is an important factor. The debris resulting from pruning should, however, be at once and carefully removed so that aphids may not be able to pass the other canes.

LEAFCURL.

Symptoms.

This also is a systemic disease and, like mosaic, once a plant is infected, it never recovers. The disease can thus readily be differentiated from the effects of girdling, adverse weather conditions, insect injuries, etc.

The typical leaf symptoms are the dwarfing of petioles, the arching and ruckling of intervenal areas and the dark green (or quite yellow) color of the leaves. The arching of the tissues between veins makes it appear as though the veins are sunken and too short for the amount of leafblade tissue developed. This gives rise also to a curling downwards of the tips and margins of the leaflets. With increasing severity of infection the leaves are reduced in size until the leaflets may be only half an inch when growth is finished. All gradations are observable on some canes from curled but slightly dwarfed leaves at the base to tiny, pale-yellow, ruckled leaves at the tip. A characteristic symptom is the dwarfing of the cane. In newly-infected canes this is perhaps only noticeable in the late growth of the tip, but it is pronounced in the canes of the succeeding season. The dwarfing is not accompanied by spindly growth as in mosaic; instead the canes are thick and stocky. While the leaves may be dark green and the cane stocky in the second season, the final condition is that of a very dwarfed cane with pale-yellow, ruckled, extremely dwarfed leaves.

The fruiting laterals are short, having an upright tendency, and with curled, compact, dark green, small leaves. The fruit spurs flower later than normal and fruit which sets is small, bitter and often with no pulp. This characteristic is quite like that in "little peach'

Varietal Susceptibility

Cuthbert, Marlboro, King and Herbert varieties are all susceptible, with Cuthbert again leading. The writer has not observed curl on Columbia, nor on Newman's varieties above mentioned.

Dissemination of the Disease.

Aphis rubiphila is shown by the work of Rankin in Ontario undoubtedly to be the infecting agent in leafcurl.

CONTROL.

The following control measures are suggested for both diseases.

1. If mosaic or curl, or both, are present in the plantation to such an extent that eradication by roguing is inadvisable, it is necessary to start a new plantation at a distance from the old. Isolate it as far as possible and plant with disease-free stock. This is of course fundamental, and no risks should be run in this respect. Watch carefully and rogue suspicious plants at once from new plantation.

2. If it is impossible to start a new pl tation, rogue diseased plants, remove th at once, and burn at a distance. Digg and removal should be carefully done that aphids are not shaken off or brushed during the process. As a result of work Ontario it appears that early eradication commercially successful. Symptoms app as soon as leaves develop and plants sho be removed when the disease is evident.

3. Not until tests for the control of aphid are completely worked out can reco mendations of that sort be made, but it obvious that in this, as in other mosaic eases, insect control is fundamental.

Co-operative Experiments in Weed Eradicatio

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Object of these Experiments

These experiments were begun in 1911 with the object of gathering data from which definite statements might be made regarding the best methods of controlling the various bad weeds of Ontario. New weeds have been added from time to time and it is hoped to add more weeds each year until exact information has been obtained concerning the eradication of all the bad weeds in the Province.

Methods of Carrying on Experiments

These experiments were carried on by farmers on their own farms following the directions supplied by the Director of Co-operative Experiments in Weed Eradication. Each year circulars outlining the experiments for the season were sent out to the farmers throughout the Province. These circulars listed the weeds to be experimented with and invited all farmers who had any of these troublesome weeds on their farms to join in the experiments. Those who properly filled in the blank application forms attached to the circulars were supplied with directions for carrying out the experiments chosen. In the fall blank forms were sent to the Experimenters on which to report the results of their work.

SUMMARY OF RESULTS OF THE ELEVE YEARS' EXPERIMENTS.

The weeds experimented with were Per nial Sow Thistle, Twitch Grass, Bladder Ca pion or Cow Bell, Wild Mustard, Ox-eye Da Field Bindweed, Wild Oats and Chess. T following is a brief summary of the resu obtained from these experiments:—

Experiment No. 1

THE USE OF RAPE IN THE DESTRU TION OF PERENNIAL SOW THISTLE

No. of experimenters.....
Reporting complete success.....
Reporting partial success.....
Reporting failure.....

Experiment No. 3

THE USE OF RAPE IN THE DESTRU TION OF TWITCH GRASS.

No. of experimenters.....
Reporting complete success.....
Reporting partial success.....

Experiment No. 4

A METHOD OF CULTIVATION FOR TH DESTRUCTION OF TWITCH GRASS.

No. of experimenters.....
Reporting complete success.....
Reporting partial success.....
Reporting failure.....

Experiment No. 5

A MEHOD FOR THE ERADICATION OF BLADDER CAMPION OR COW BELL.

No. of experimenters	9
Reporting complete success	5
Reporting partial success	4

Experiment No. 6

SPRAYING WITH IRON SULPHATE TO DESTROY MUSTARD IN CEREAL CROPS.

No. of experimenters	24
Reporting complete success	21
Reporting partial success	2
Reporting failure	1

Experiment No. 7

A METHOD OF CULTIVATION FOR THE DESTRUCTION OF OX-EYE DAISY.

No. of experimenters	3
Reporting complete success	2
Reporting partial success	1

A METHOD OF CULTIVATION AND CROPPING FOR THE SUPPRESSION OF FIELD BINDWEED.

No. of experimenters	4
Reporting complete success	2
Reporting partial success	1
Report not complete	1

General Results of the Experiments

1. Over eighty farmers have carried on successful experiments. The weeds experimented with were Perennial Sow Thistle, Twitch Grass, Bladder Campion or Cow Bell, Wild Mustard, Ox-eye Daisy, Field Bindweed, Wild Oats and Chess. Those who took part in these experiments profited by the experience. In nearly every instance they cleaned the field experimented with and demonstrated to their own satisfaction the effectiveness of the method tried, and at the same time their results furnished practical information for others.

2. As a result of the data gathered from these experiments it is now possible to recommend with confidence definite methods for the eradication of such weeds as Perennial Sow Thistle, Twitch Grass, Bladder Campion and Wild Mustard.

RECOMMENDATIONS MADE FROM THE RESULTS OF THE EXPERIMENTS.

The results of these eleven years' experiments would warrant recommending the following methods for the eradication of Twitch Grass, Perennial Sow Thistle, Wild Mustard and Bladder Campion.

The Rape Method for the Control of Perennial Sow Thistle and Twitch Grass.

Cultivate the field until about the middle of June, running over it frequently with the cultivator so as to keep the tops down and thus weaken the "roots." A cultivator with broad points should be used which will cut off the Sow Thistle or Twitch Grass below the surface of the ground and not break up the rootstocks too much. About the middle of June apply manure at the rate of about twenty tons per acre (twelve good loads.) Cultivate the manure in thoroughly and with a double mould board plow slightly ridge up the land, making the ridges about twenty-six inches apart. On the ridges sow pasture rape (Dwarf Essex variety) at the rate of about one and a half pounds per acre. It is important that the right amount of rape be sown for if too little is sown the stand will not be thick enough to smother the weeds and if, on the other hand, too much is sown the rape plants will be too crowded and not grow vigorously enough to keep ahead of the twitch grass or sow thistle. Sow the rape when the land is sufficiently moist to secure quick germination of the seed. If the rape is slow in starting the twitch grass or sow thistle may get a start in the rows and thus necessitate hand cultivation. Cultivate the rape every week or ten days until it occupies all the ground and makes further cultivation impossible. If, when the rape is cut or pastured, any of the weeds remain, the field should be ridged up last thing in the fall and put in with another seed crop the following year. This has not been found necessary when a good stand of rape has been secured.

Method of Cultivation for the Eradication of Bladder Campion or Cow Bell.

Badly infested fields should be plowed deeply in the fall and then cultivated and cross-cultivated with a broad-shared cultivator in order to break up and weaken the underground rootstocks. In the spring this cultivation should be repeated frequently enough to prevent the plant making any growth above ground until it is time to put in a hoed crop, which must be kept thoroughly clean in order to be effective. A well-cared for corn crop planted in hills so that it can be cultivated both ways has been

found to give excellent results. Special attention must be given to hoeing out any bladder campion plants which may appear in the corn crop and which are not destroyed by cultivation. One fall and one spring's thorough cultivation followed by a well cared for hoed crop has been found to destroy practically all the bladder campion in a field except in exceptionally wet seasons.

Spraying with Iron Sulphate to Prevent Mustard from Seeding in Cereal Crops

Iron sulphate or copperas can be successfully used to destroy mustard in standing grain without injury to the crop.

Preparation of Solution.

A 30% solution should be applied. This can be prepared by dissolving 80 pounds of Iron Sulphate in forty gallons of water. Iron Sulphate is dissolved quite readily in cold water. The solution should be strained through a cheese cloth, as it is put into the spray pump tank. This will remove dirt and small particles that are apt to clog the nozzles.

Time to Apply.

Apply on a calm clear day just as soon the first few plants in the fields show flowe *It is very important to spray early.* If plants are left too long the treatment is nearly so effective. If a heavy rain con within 24 hours after the solution is appli it will be necessary to spray again.

How to Apply the Solution.

An ordinary hand pump barrel spray such as is employed to spray fruit trees m be used, or a potato sprayer can be fitted to do this work. Many of the up-to-da sprayers have a special broadcasting tachment for spraying weeds. These are e cellent for large areas, as they cover a wi strip at each round. Care must be taken see that every Mustard plant is covered wi the solution in the form of a fine spray.

Iron sulphate may be obtained at a hardware store or from The Nichols Chem cal Company, Toronto. In wholesale lots is better purchased from this Company, wh can supply it much cheaper in larger qua tities than it can be purchased at local har ware stores.

Book Reviews.

Text Book of Agricultural Bacteriology.

F. Löhnis, Ph.D., and E. B. Fred, Ph.D.,

Published by McGraw-Hill Book Co., New York, 1923.

This text book is largely a translation of Dr. Löhnis' "Vorlesungen ùber landwirtschafliche Bakteriologie", published in 1913, now revised and re-arranged to make it more useful to the American student.

It attempts to give, as the preface states, "an accurate and fairly complete view of this new and wide field of knowledge", and the authors have tried to accomplish this task in 272 pages of text.

The authors define as agricultural bacteriology the study of bacteria and other micro-organisms in their relation to foodstuffs, milk and dairy products, and the study of the bacterial processes in manure and in soil. They exclude animal and plant diseases.

After a short historical introduction in which the earliest bacteriological hypotheses, observations, experiments, classification and practical application are mentioned briefly, the authors pass on to the general morphology and physiology of bacteria and related micro-organisms, in a series of seven chapters and 123 pages. Compared with the average text book that deals with the activities of bacteria, the sections relating to t nitrogen, carbon, oxygen and hydrogen cycl the transformation of mineral substances, et are somewhat more fully and clearly set fort Some seven or eight pages regarding the path genic action of micro-organisms concludes th section which, considering the earlier statemen of the authors, might well have been omitted.

Part II of 123 pages is devoted to Dairy a Soil Bacteriology, one chapter on the relation bacteria to foodstuffs, three chapters on bacter in their relation to milk, butter and cheese, one o sewage disposal, one on organisms in barnya manures, and one on bacteria in soils.

The book is clearly and concisely written, i corporates the results of recent research, has sufficient number of references to direct the rea er to special literature, is well illustrated wit several plates in colour, most of which have bee taken from the German edition. A few hav been changed to conform with American usag but a more modern hot air sterilizer might hav been figured and Figs. 26 and 51 and 52 could b changed with advantage.

F. C. H

Land and Rural Settlement.

A Suggested Policy for Federal and Provincial Governments.

D. ALGAR-BAILEY, F.R.G.S.

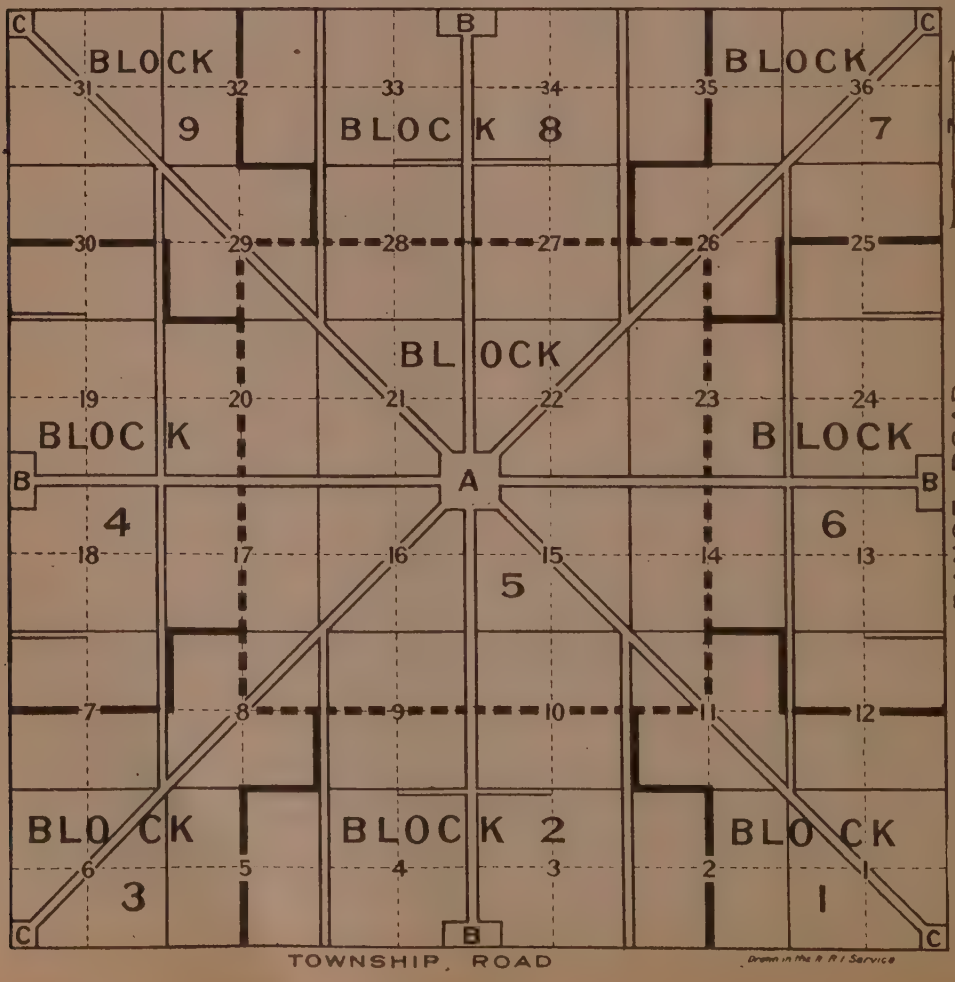
Fellow Royal Colonial Institute.

The unsatisfactory condition of the farm- g industry at the present time—and dis- te of this one can hardly consider possible view of the recent addresses by Progres- es in the Federal House, and the alarming- heavy migration from the land—makes it opportune time to deal with the living d social conditions of our rural popula- n. Whilst it is not the purpose of this ticle to analyse this side of agricultural e, but rather to take it for granted we are reed it is one demanding serious atten- n, yet before proceeding the writer would e to leave a few thoughts for considera- n. Perhaps not the least of Canadian oblems is the heavy migration to the coun- to the south of us, which it cannot be mitted is entirely the result of economic nditions. The average income from the rm is but little lower here, if any, than it in the United States, and further our nd is cheaper to buy and our grain crops a higher standard. As in America so in nada the value of field products is govern- by the world's market. True we have our cal problems, but so also has the farmer in e United States. The vagaries of Nature e common to all countries, and we in no y stand alone as sufferers from drought, il, frost and pests. We perhaps, despite our ghly efficient training centres, are not so prough in our work as are the people of e older countries of the world, with gen- ations of farmers behind them, but that is st as true of farming in America. Both untries offer practically the same oppor- nity for the skilled man, and harass him th trying climatic conditions and a seeming difference to his complaints of unfair treat- nt.

One explanation of migration to the States hich might be considered, is the return of ge numbers of town and city people who me here as a result of the free land policy, d did so only with the idea of "proving up" d selling out. One wonders how many of them would have remained, and how many more experienced agriculturists would have come here, and be coming here today, if living conditions were different to what they are. A possible answer might be found by considering what would happen if Great Britain, France, the Southern States and other countries of superior climatic and rural conditions were to adopt a similar free land policy. Would one be far wrong in saying that the rush from Western Canada and the northern States would cause their almost complete de-population? Why? Because economic conditions would be better? No, it is not likely that they would be, but because rural life in those countries is more enjoyable than it is in lands criss-crossed by barb-wire fences, devoid—or almost so—of trees and foliage, and in which people live in semi-isolation as result of the adoption of an incomplete immigration and settlement policy, and one which so far there seems to be no indication of intent to complete. It is futile to say, "Conditions will become better in time," because they will not become better unless we start in to make them better. Closer settlement will not come as result of immigration unless migration is materially decreased, and migration will not materially decrease until rural conditions are better. It is futile, also, to talk of building up a civilization in Canada which in one or two hundred years time will be the superior of any other, unless we lay the foundation by getting a sturdy intelligent class of settler, and improve the calibre of those already here. We can do neither unless we better social conditions on the land, and so provide for intellectual development. Moreover, a continuance of the present methods will see us in a hundred years still an empty country, or else a land dominated by the flotsam and jetsam of the world—white, yellow and black. The writer is convinced that the first step necessary for Canada to take is the adoption of a scientific land and rural settlement policy, and in the following

pages will describe a plan of Rural Settlement recently developed by him.

Rural settlement for the Canadian agrarian is by no means a new idea, but has from time to time received the careful thought of a number of people. Of note amongst these were Earl Grey, who whilst Governor General brought forward a plan for ameliorating the living conditions of those on the land, and Sir William Van Horne, late president of the Canadian Pacific Railway, who developed a scheme which secured very favourable comment from a number of government officials. In 1917 an exhaustive report on Rural Planning and Development was prepared by Mr. Thomas Adams, of Letchworth Garden City, England, for the Commission of Conservation, which body as part of its activities investigated "social conditions in rural areas and the prevailing methods of land settlemer Nothing further seems to have been done result of that investigation and rep although most undesirable conditions w brought to light, and practical suggesti made for great improvement. There is, can safely say, almost universal agreem as to the desirability of rural or group tlement, as long as it is not of an artifi or compulsory nature. Difference of op ion, however, is present concerning the ec omic advisability of a farmer living off actual field of operation. To the lay m the impression comes that if opinions equally divided, then there must be a mid course, and that even at the risk of a sligh lower farming efficiency, it is better to prove living conditions if by so doing l settlement is further encouraged.



In development of the Rural Settlement Plan about to be described, the necessity for adhering to the existing chequer board system of survey was a first consideration, because it meant non-disturbance of records and ease of adoption in partially settled districts. Equally, it was realized that distances and cost of inauguration would be all-important factors if success was to be met with. The diagram shows that the plan calls for division of townships into nine blocks; the establishment of hamlets and villages at the points "A", "B", "C"; the closing of fourteen miles of section roads; the opening of two diagonal "trails" across the township. It will be apparent to those conversant with the survey map of Canada, that with every township planned in similar manner, the points "B" will become the centre of two blocks, and the points "C" the centre of four blocks. Recapitulating on that basis: "A" is a grouping centre for nine sections, "B" for eight sections, and "C" for eleven sections. The actual details of development are briefly set out in the following summary of specifications.

SUMMARY OF SPECIFICATIONS.

Rural Blocks. Each legal township is subdivided into nine blocks of shape and area shown in the diagram. Numbered east and west as is the usual manner, their areas are as follows:—

Blocks 1, 3, 7, 9,	containing each,	11	¼ secs.
" 2, 4, 6, 8,	"	16	"
" 5,	containing	36	"

Settlement Acreage. Reservations within Rural Blocks and proportionate in area to the number of quarter sections within the said blocks. On the basis of 2½ acres per quarter section, the acreage in each Rural Block will be as follows:—

Blocks 1, 3, 7, 9,	27.5 acres		(C in diag.)
" 2, 4, 6, 8,	40	"	(B in diag.)
" 5,	90	"	(A in diag.)

NOTE. Although necessary in the diagram to indicate a definite site for reservations, the actual position will at all times depend upon topographical and other local conditions. Likewise it is impossible in the case of Blocks 2, 4, 6, 8, and 5, to state that the acreage to be reserved will be proportionate in the adjacent quarter sections.

Rural Plots. Approximately 2½ acre subdivisions of settlement acreage, and open for purchase by any settler whose land is within the area of the tributary Rural Block. One to be available for every quarter section, but not more than two to be sold to any one settler. The purchase price to be the selling value of land in that district, with an additional nominal government fee.

Plot Titles. These when issued to a settler would contain restrictions governing transfer and usage. A fee of $10 to be charged to meet government expenses.

Hamlets. The aggregate Settlement Acreage in every Rural Block when inhabited by a definite number of people will constitute a Hamlet.

Villages. A Village will be constituted when; (1) Two Hamlets face each other on a township or range road respectively ("B" on diagram); (2) two or more Hamlets face each other at the intersection of a township and range road ("C" on diagram); (3) when a Hamlet shall have erected a school house.

Each Village and Hamlet will be named by its inhabitants, but when Hamlets face one another on the same road, or at the intersection point of two roads, one name only shall be adopted.

Residence in a Hamlet or Village is purely a matter of option. A farmer can either remain on his farm, or purchase a plot and live in a group.

Schools. These will be erected within settlement acreage area, and the laws governing their establishment will not be changed.

Supervision. Hamlets and Villages would need no official recognition other than that of "School District", or "Postal Point". School Trustees, or other appointed or elected committee would exercise general supervision, and be the point of contact. If municipal status was desired the present legislation would meet all requirements.

Roads. Of the present 42 miles of 66 ft. roads within a township, 14 miles will be closed. 16 miles reduced in width to 22 ft., 12 miles reduced to 40 ft. The total road area so closed is equivalent to approximately 29.4 miles of 66 ft. roadway. The main roads will be as follows:- (1) The present N. & S. road which is located half-way be-

tween the Range roads; (2) A new E. & W. road to be opened up halfway between the Township roads. These main roads to be 40 ft. in width. The two present E. & W. roads to be closed.

The subsidiary roads will be the remaining four N. & S. roads with their width reduced from 66 ft. to 22 ft., and certain portions closed, i.e., one mile at both ends of the 1st and 5th roads west of the Range road; and the centre two miles of the 2nd and 4th roads respectively.

Trails. As indicated in the diagram a Township is traversed by two diagonal 22 ft. wide trails. Full right of way is required, but every farmer retains the right to erect gates at one or both ends of that portion of a trail crossing his land.

The eight half-mile trails shown in the diagram are feeders to individual quarter sections, and will only be a right of way over a portion of closed road allotted in exchange (see note).

NOTE. It is proposed that the area freed by closing of roads, be allotted proportionately to the owners of lands traversed by trails and the new E. & W. main road. The closed roads are adjacent to such lands.

Fencing. Owing to the closing of 14 miles of roads the amount of fencing in a township will be reduced by like amount. If protection is given by gates at certain points, it should be possible to also dispense with fencing along all subsidiary roads, but in no case should diagonal trails need fences if gates are placed at road inter-section points.

Distances. The average distance of quarter sections to their respective Village or Hamlet is .93 mile, and in the case of half sections it is .72 mile. The following table is in further explanation:-

Number of	½ Mile & less	Not over 1 mile	Not over 1½ miles	1⅞ miles	Total
¼ Sections	52	36	48	8	144
½ Sections	32	31	7	2	72

Acquiring Settlement Acreage. When existing settlement permits, the necessary acreage will be acquired by an exchange between the School Lands and Dominion Lands Branches of the Federal Government. In new surveys the Crown could retain the right to lease or purchase for settlement purposes, any one legal subdivision (40 acres) in every quarter section. Further, other land in li of sections 11 and 29 could be reserved School Lands, and settlement acreage acqu ed in that manner.

When land is privately owned the nec sary acreage can be obtained by means of special term contract, or if unavoidable, expropriation. Legislation might be pass empowering Governments to summarily lea or purchase any portion of a tract of la lying uncultivated for more than a certa number of years.

The special term contract would take t form of a lease with option to purchase a or certain portions of the leased area, t owner retaining full right of usage in a unsold portions.

Expense and Revenue. The field and r cord work entailed in putting the plan in operation could be taken care of by existi staffs. No land would be purchased by t government except upon request and recei of the purchase price and fee. The cost administration should be covered by reven from fees.

Certain parts of the foregoing matter i dicating phases of development, are real more suggestive than specific in nature, b provide a basis from which to work. Numero other features and alternatives could be me tioned but seem at present unnecessary. A tention might be directed to the great advan age it would be if the diagonal trails we made the main roads of a township, but th could likely only be done in new territor The possibility of eliminating many miles section fencing deserves careful thought, f with the farmstead in the Village or Haml the only fences seemingly necessary, a those for protection of growing crops. T area allotted to sections as result of road r duction is sufficient to enable farms to separated by fireguards, but of such widt that they would also provide road spac this would mean great saving in time, mone and labour. In sections traversed by trai there are natural 200 to 240 acre farm formed, as well as three-sided half section (320 acres)—not an objectionable shap when no fences are erected. With the diago al trails recorded, the legal description areas of such size or shape would be cove ed by use of the word, "triangular". For i

stance, a 240 acre farm in section eleven would be easily found by being describing as, "The S. W. Quarter and the S. W. Triangular of the S. E. Quarter of Section 11." A three-sided half of the same section is properly described as being "The S. W. Triangular of Section 11."

An important aspect is that of schools being in close proximity to the population. It means steadier attendance of the children—impossible when they live several miles away—and more encouragement for competent teachers to go out to country schools. One cabinet minister of a prairie province stated to the writer last year that the adoption of the plan would, "completely solve the Consolidated School District problem." Similar view has also been expressed by a number of western farmers, who have also pointed out the great advantage of having a school house "across the street to have dances and other social recreation in." It most certainly facilitates technical instruction to have groups and suitable premises for lectures. One wonders, too, how long it would be before some enterprising firm formed a moving picture circuit. One could possibly leave it to those concerned with tree planting to see interest in that stimulated, and with one farmstead showing signs of improvement others would not be long in following the example set.

The effect of immigration might also be briefly considered. There is a strongly organized movement in Britain to encourage group settlement in the oversea portions of the Empire, and should Canada announce it had made such a thing possible it would meet with cordial approval. If the population of any suitable district in Britain could be informed that a definite area was available in Canada, and that they could create villages and name them after those they were now living in in Britain, the result would surely be a stimulated interest in Canada. Sentiment after all plays a very large part in everybody's life—perhaps even the largest—but appears to have been the very thing overlooked throughout the past by those directing our immigration and land settlement policies.

The writer is of opinion that apart from the distinct social advantages to be engendered by the adoption of this scheme, the facility of educational work in group centres, and the beautifying effect it would have on rural Canada, there are distinct economic advantages such as the saving in expense of road construction and upkeep; the checking of the weed menace consequent upon the closing of roads; the possibility of other industrial work in winter months. There is, also, the outstanding fact that even with moderate land settlement, the revenue from fees would be no small amount and sufficient to pay all costs of administration. It is not expected that the plan would be adopted to any large extent in well settled districts, but where settlement is sparse and buildings are small, it should be as easy of adoption as it would be in vacant territory. That the wives and children of agriculturists would welcome the release it offers from mental and material isolation, goes almost without saying, and with no interference of right to live on his farm if he so prefers, there is but little reason to expect opposition from the farmer himself. The value of the scheme can be easily demonstrated by the Federal Government adopting it as an experiment in a few townships in different parts of Canada, and to do so would be very little expense. With the lead set it would be merely brief time before the Provinces, seeing the advantages, would take the initiative themselves.

In conclusion the writer suggests that our task today is to take what the exploiters have left of our country, and start in developing it. Lack of organised direction and scientific handling of land settlement in general, has cost us millions of dollars and set us back at least two decades. As result we have on our shoulders a burden of taxation which will remain for several generations, and a population several millions less than it would have been, had we heeded more the legend of the tortoise and the hare and listened less to the idle vapourings of the over-eulogised "boosters"—a class perhaps more fittingly described as, "commercial inebriates." The over twenty million acres of vacant cultivated farm and arable lands is silent testimony to the suffering we have brought upon ourselves—as silent as the little white crosses in Flanders Fields, and for the sake of those who are to come after, it is time we were up and doing.

A FEW OPINIONS.

There is but little doubt that the article "Land and Rural Settlement" which appears in this issue, will be read with considerable interest. We believe the subject to be a timely one, and one to which the Canadian Society of Technical Agriculturists might well devote attention. The social and the economic surely interlock the one with the other. Satisfactory living conditions are as essential to the industry of Agriculture as is a practical knowledge of the industry itself, but it would almost seem as if it is a phase which has been sadly overlooked. Mr. Algar-Bailey has expressed the hope that those interested in the plan will write him in comment and criticism; his address is P. O. Box 193, Ottawa. We give below some of the opinions expressed by well known people who are supporting the project, and who hope to see it tried in an experimental way in some of the Western provinces. (Editor).

"The plan appeals to me very greatly, and I most certainly favour its adoption."

HON. HEWITT BOSTOCK, Speaker of the Senate.

"I am satisfied that this plan of Rural Settlement is worthy of most serious consideration."

ROBERT FORKE, M.P., Leader of Progressive Party.

"Any system of Land Settlement which takes into account the development of community life as you have in view seems to me to be very sound. Where topographical and existing settlement conditions warrant, your plan seems admirable."

C. A. MAGRATH, Chairman, International Waterways Commission.

"The scheme appeals to me on economic grounds. I see in it a material reduction in the cost of municipal administration; decrease in the expenses of the farm home, and in telephone and transportation costs; also greatly improved educational facilities. For these reasons and the obvious social advantages it would bring, I strongly favour its adoption."

J. H. GRISDALE, Deputy Minister of Agriculture, Ottawa.

"The putting into operation of this plan would, of course, solve the district school problem on the Prairies—in itself sufficient cause for its adoption."

HON. A. J. McLEAN, Late Minister Public Works, Alberta.

"The writer is to be congratulated on having evolved a practical scheme for Community Settlement which appears to have all the elements to make it a success."

H. STUTCHBERRY, Trade Commissioner, Alberta.

"The idea is very commendable; there can be no question whatever as to the advantages from a community life—it would seem that in the West some such plan might be feasible—it might be developed in some parts of the East."

H. BARTON, Professor of Animal Husbandry, Macdonald College, Quebec.

"Your scheme is a carefully thought out one and I am very much interested. Life out here is hard on the women folk but community living would greatly improve things. Naturally there are objections but they are not such as should stand in the way of its adoption. I should like to see it tried in a favourable district."

E. A. HOWES, Dean, Faculty of Agriculture University of Alberta.

"No one would dispute the value of community life in Agriculture, and I see no reason why a farmer should not reside at a nominal distance from his grain fields if he so desires. There is a great deal to be said in favour of group settlement such as you suggest, but I believe the primary reason for rural depopulation is economic."

F. M. CLEMENT, Dean, Faculty of Agriculture, University of British Columbia, B.C.

"I have read with the greatest care your Rural Settlement Plan. For years I have seen the advantages of such a system of settlement as you suggest."

SIR JOHN WILLISON, Late President Canadian Colonization Association.

"I am thoroughly in accord with the principles of your scheme and hope you will be successful in obtaining the sympathy of those in a position to give them effect in some form."

THOMAS ADAMS, Town Planning Adviser.

"Any plan which could be put into successful operation to even partially eliminate rural isolation, is of the greatest national importance."

Federal Research Council, Ottawa.

Plant Pathology in the Public School.

W. A. McCUBBIN

Pennsylvania Bureau of Plant Industry, Harrisburg, Pa.

Every plant pathologist who has attempted to explain the life history of some common pathogene to an agricultural audience has had at times an instinctive feeling that his hearers have not grasped his message, and in a baffled and helpless state of mind is likely to accuse his audience of stupidity or blame himself for ineffectiveness. Perhaps neither conclusion is quite justified. A fairer judgment might assign the cause of these exasperating situations, not to lack of mental ability on the part of either speaker or hearer, but to simple ignorance on the part of his audience of even the fundamental phenomena connected with the fungus and bacterial world,—a world which is real and vivid to the scientist, but which to the layman has merely a formless, fourth-dimensional existence.

Many speakers on plant disease subjects sense very keenly this vital lack in their hearers, and in addressing gatherings of this kind spend a great part of their allotted time in trying to create in the intelligence before them some concept of these unknown forms of plant life, in the hope that when an outline of control measures is tacked on at the end, these will be accepted as reasonable and acted on as such. The speaker rightly assumes that if a grower once obtains a clear and definite idea of the nature and habits of his fungus enemy, he will not only adopt methods of control more readily, but will carry them out more rationally.

The psychological rightness of this assumption is unquestioned, and the fact that a preliminary talk on the nature and habits of fungi is such a common practice in public addresses indicates very clearly that the weak point in our system is the "ultimate consumer,"—the agriculturist himself. Only when this individual comes to regard fungi and bacteria as personal, every day realities, and has a real if limited conception of their mode of life, will he become enthusiastically interested in his own problems of plant disease.

We have now arrived at a stage in the development of plant pathology where this inertia of ignorance is more important than ever before. In the first place it prevents the country from reaping the full results of our accomplishments. We have on this continent the best organized and most efficient system in the world for research, demonstration, and publication. It is gigantic in extent, universal in its activity, and magnificent in achievement. It gives lectures at every crossroad, clogs the mail with bulletins, and floods the public press with information. Yet only too often, and too universally, the lecture meets indifference, the bulletin is carelessly thrown away, and the news reader passes by our well-written contribution and turns over to the sporting page. We all know that the average man has little definite realization of his losses from plant diseases, that he but dimly, if at all, recognizes them as the work of parasites, that the mode of life and reproduction of these parasites is a sealed book to him, and that control measures are in many cases neither willingly undertaken nor carried out with accuracy and intelligence. It is equally obvious that if every citizen engaged in the cultivation of farm, orchard, or garden, had the simple kind of knowledge which the speakers already referred to try to impart during an address as an emergency measure, and if this knowledge was as much a part of a citizen's ordinary educational equipment as fractions or spelling, then our continent would soon be far on the way to securing the full benefits from what we already know and are able to do. One might go further and say that until this hindrance to the full development and utilization of our control methods is removed, we will continue to serve the best interests of the public under an enormous handicap.

Aside from this idea of more complete service to the public, there is a second phase of the question which touches all plant pathologists very closely. Human life in the present day has become exceedingly complex and exacting. Within our own little division of science expansion has been so great

that most of us have been forced to specialize into certain restricted fields. It is entirely possible that our knowledge will soon become so vast, and its structure so intricate, as to be hopelessly beyond the grasp of the layman. The medical profession has now reached the situation to which we are drifting so surely. But our position is vitally different from that of the members of the medical fraternity; their system of private fees permits them to maintain themselves more or less independently of popular support, while in the nature of things plant pathologists must long continue to be public servants. Our status in the community therefore, depends directly on public understanding and sympathy, and the future of each of us as individuals as well as the success of our science is bound up with the intelligent support of the country at large. Unless the body of the people understand and appreciate what we are trying to do for the common good, they will treat our work with indifference and neglect instead of encouragement; and it should need no intellectual giant to see that sympathy and support will exist only where there is sufficient knowledge of the basic facts and principles involved. To put the matter shortly: no knowledge, no sympathy; no sympathy, no support.

In view of these considerations let us ask ourselves: Can we afford to overlook any means which will make our public service more complete? Should we not open wide and keep open every channel of communication between ourselves and our constituents? Is it not a wise policy to bridge the widening gap between our ever more involved science and a public bewildered by countless new distractions?

If we are convinced that in order to fill, and continue to fill, our ordained place in modern life, we must get into the intellectual equipment of the average man enough of the rudiments of our science to enable him to observe with accuracy, to listen with intelligence, to read with interest, and to put into practice in a rational way what we can recommend, then we may venture to look about us for means to accomplish this desired result. One turns naturally to our colleges and universities. They are doing a noble work, and it is not too much to say that the leaven they have stirred into the community in the past has been the chief means in ing our science to its present position. it should be our larger aim to reach the lions who are outside the direct influenc these educational centers and for such a only one agency in the land possesses advantages which make it capable of ful ing this purpose. It is the public school tem. This agency is well organized; draws its information from common sou which we can utilize; it penetrates e nook and cranny of the land; it affects p tically the whole population; it reaches people when they are young, inquiring plastic; and it is the common cha through which passes all that goes to m up the everyday education of the whole p ple. In short the public school system is mirably adapted to satisfy our most rigid quirements, provided it can be made use for the purpose.

Of the objections that have been rai against introducing subject matter pert ing to plant pathology into primary scho the first is that it will encumber an alre crowded curriculum. We may safely regard this objection, for if the subject m ter fills a vital need in education it will fo its way into use with but little help from A more serious objection is usually expr ed thus: How can you teach children a thing worth while of a science involv plants of microscopic size, a science bristl with long Latin names and technical ter Let us put this same question in another w Can we, by simple methods, demonstrate important features in the life history fungi, make these stages real, and then c nect this knowledge with the rest of child's world? Can we show him spo mycelium, various types of spore-bearing gans, spore dispersal? Can we get him see that such a thing as a rot is the effect fungus activity, and enable him to dem strate this activity to himself by sim inoculation ? Can we lead him to obse diseases, connect them with the pathoge and estimate losses due to them? Can count on guiding his constructive imagi tion to build on this basis of fact, and s retain the all-important factor of realit Can he thus arrive at the principles wh underlie disease control, food preservati timber protection, and those other eleme

ich would serve as an admirable back-ound for the lecture, the bulletin, or the wspaper article of ten years hence?

I think we can give a confident affirmative all these questions, and if we can do so, n the needs of the agricultural public and future success of our own science both ge us to translate our confidence into ac-n.

At the present time a scheme for introduc-some fundamental instruction on plant eases is being worked out in co-operation th the Department of Education of the ate of Pennsylvania for use in the state. It mprises a part of the general subject of ture Study along the lines suggested by above questions and the plan includes,--) A small illustrated text for use by the cher, covering the general field of "the ace of fungi in nature," with special re-rence to plant diseases; (2) a set of ex-cises devised to demonstrate the reality of ngi, their life histories, and their various ndamental relationships to human affairs. ese exercises include such things as spore-prints of gill and pore fungi, the growing of molds, production of carbon dioxide by yeast, study of fruit rot by inoculation, as well as field determination of disease losses in simple cases such as oat or wheat smut. In planning these exercises great care has been taken to utilize only materials of universal and abundant occurrence; second, to use a method so simple that the results can be obtained by even the most inexperienced; and third, to call for only such apparatus as can be found in any community, and which costs little or nothing; (3) a collection of common diseases to stimulate observation, and to familiarize the pupil with the range of diseases and their individual peculiarities; (4) a set of fifty questions concerning those features of everyday life in which fungi and bacteria touch human affairs. These are designed not only to test a pupil's knowledge, but to direct thought to these matters, and thus widen his conceptions and develop the power to interpret the phenomena of everyday life in the light of present day scientific knowledge.

Applications For Membership, C.S.T.A.

During the past month the following ap-ications for regular membership in the nadian Society of Technical Agriculturists. ve been received. The addition of these mes brings the total membership list to 0.

T. Chesley, (O.A.C. 1922, B.S.A.) Toronto.

C. Creelman (O.A.C. 1888, B.S.A.) Toronto

L. Doughty (Alberta, 1921, B.S.A.), Edmonton, Alta.

Fulton, (O.A.C. 1921, B.S.A.), Toronto.

H. Gandier (Toronto, 1911, B.S.A.) Vermilion, Alta.

J. Lawellin (Oklahoma, 1910, B.S.) Winnipeg, Man.

S. Longman (Manitoba, 1913, B. S. A.) Raymond, Alta.

G. Major (McGill, 1921, 1922, B. S. A., M.Sc.) Ottawa, Ont.

H. W. Malyan (Toronto, 1920, B.S.A.) Olds, Alta.

H. McArthur (Alberta, 1921, B.S.A.) Claresholm, Alta.

G. E. Patton (O.A.C. 1922, B.S.A.) Toronto.

L. M. Ogilvie (Toronto, 1921, B.S.A.) Cadillac, Sask.

R. M. Scott (Queens, 1917, B.A.) Olds, Alta.

G. A. Richardson (Toronto, 1920, B.S.A.) Claresholm, Alta.

P. R. Talbot (Toronto, 1907, V.S.) Edmonton, Alta.

Robert Thomas (Montreal, 1922, B.S.A.) Montreal, P.Q.

C. J. Watson (McGill, 1921, B.S.A.) Ottawa.

C. A. Weir (Manitoba, 1917, B.S.A.) Olds, Alta.

Etude sur le Progrès et les Conditions d'Existen

J. H. LAVOIE,

Ministère de l'Agriculture, Québec, P.Q.

En présence des progrès merveilleux réalisés jusqu'ici dans le domaine de la science et des transformations et modifications incessantes produites par des actions physiques et chimiques à la surface de notre globe, d'aucuns se sont parfois demandés anxieusement si, au terme de ces développements, l'habitat humain ne finirait pas par redevenir une sorte de paradis terrestre.

Lorsqu'on considère attentivement les relations du passé et du présent entre les être vivants et leur milieu, il semble que toutes les hypothèses fondées sur la loi du progrès soient plutôt présomptueuses que vraisemblables tant est décevante la réalité.

L'observation judicieuse des réalités nous permet en effet de conclure avec certitude que le progrès pratique continuera d'améliorer encore considérablement les conditions actuelles d'existence des êtres vivants, mais jamais au point rétablir l'harmonie entre ceux-ci et leur milieu vital, parce qu'il existe un conflit inéluctable entre les lois qui gouvernent les forces physiques et celles qui régissent les organismes.

Aussi, dans leur impuissance à déroger à ces lois, c'est-à-dire à rétablir l'accord entre le climat, le sol et la végétation, les êtres vivants, plante, animal, homme, seront-ils toujours-quels que soient les perfectionnements et les modifications à venir-dans l'impossibilité de se soustraire à la lutte pour l'existence.

Seul, l'homme pourra trouver dans le progrès, par la puissance de son génie et la force de son travail, un correctif capable de diminuer l'intensité de cette lutte à laquelle il fut assujetti à l'instant même où il était pour jamais dépossédé du séjour enchanteur qu'il avait jusque-là habité.

En dépit des prédictions optimistes, la terre s'accommodera donc toujours fort mal aux besoins de la vie et les hypothèses les plus expectatives et les mieux étayées s'effondreront fatalement au contact des heurts violents et des à-coups de la réalités.

Parce que la nature est défavorable vie de l'homme, c'est-à-dire, parce qu milieu physique ne réunit pas toutes les ditions qui pourraient le soustraire famine, aux intempéries, aux fl de la nature, aux maladies, est dire qu'il doive se laisser ass par le fatalisme, sans tenter de réagir c le rigueurs de la destinée ?

Que nous révèlent à cet égard les conq jusqu'ici faites par le génie humain, s n'est "*que tout progrès doit être acqui mérité par de longs efforts personnels*".

N'est-ce pas en effet au prix d'eff d'activités et d'énergies intenses et cont que l'homme ait pu réussir à diminue inconvénients de la vie, i.e., à obvier maladies, à parer aux disettes et intempé à utiliser les forces de la nature pour loger, se chauffer, s'éclairer, se défendr déplacer, pour opérer les transp et établir des communications intellectuel

Si, comme tout le dénote, l'homme est venu à modifier en sa faveur les pires ditions naturelles d'existence, s'il a réagir aussi puissamment sur le milieu sique, peut-on concevoir qu'il impuissant à améliorer, dans proportions équivalentes, les condit sociales défavorables à son pe tionnement physique, moral et intellec et partant, à se créer un milieu social m approprié à ses besoins et plus conform ses désirs?

Pour étrange que cela puisse paraît a-t-il en effet paradoxe ou erreur à affi que l'homme des agglomérations urba (2) n'y trouve pas encore réunies toutes conditions favorables d'existence auxqu lui donnent droit les lois les plus élé taires d'hygiène sociale et morale !

Est-ce trop assombrir la réalité qu prétendre qu'il y est réduit à une servi économique déprimante qui entrave plication de ces lois et qui épuise-quand ne les tarit pas- ses sources d'énergie sique et morale! (3)

Or, parce que le milieu social subit l'influence fatidique du milieu physique (4) qui pousse l'homme agissant en collectivité à satisfaire ses besoins et ses désirs au détriment de ses semblables, s'en suit-il qu'il doive déployer moins d'efforts, d'activité et d'énergies pour réagir contre la spoliation, l'utilitarisme et les forces économiques parasitaires (5) qu'il n'en met à redresser, capter et utiliser les forces naturelles?

Etant lui-même la raison de toute manifestation économique, ne pourrait-il pas, pressé comme il l'est par une force irrésistible à fuir la douleur, (6) trouver, dans l'analyse raisonnée des phénomènes sociaux, un correctif capable de remédier au déséquilibre (7) de ses propres facultés et diminuer ainsi l'impulsive pression du besoin qu'il ressent d'être heureux?

D'ailleurs, le degré d'avancement atteint jusqu'ici par la civilisation ne constitue-t-il pas le témoignage le plus irrécusable de la puissance de l'action de l'homme sur la nature et sur ses semblables en vue d'améliorer la vie économique?

Si donc, d'une part, la puissance de l'action de l'homme augmente en proportion du degré d'avancement de la civilisation dont le développement correspond à l'extension des besoins (8), et que, d'autre part, les besoins sont les mobiles de toute activité, n'est-il pas permis de conclure que l'homme est lui-même l'artisan du progrès qui lui procure un bien-être relatif ou "un bonheur augmenté par un malheur diminué" (9).

Après avoir esquissé ce que l'on pourrait appeler les conditions d'existence précises de la réalité terrestre, et établi que l'homme peut parvenir - sinon à transformer son habitat en un séjour paradisiaque, du moins- à améliorer sa vie économique, il reste maintenant à déterminer *comment* il peut y arriver.

L'investigation minutieuse des phénomènes sociaux nous révèle que l'homme ne pourra améliorer sa vie économique que par l'intensité de son activité individuelle (10) et par la subordination de ses instincts (11) et besoins aux lois qui les régissent.

Or, de toutes les lois qui délimitent les sphères d'activité ou qui définissent la nature des rapports de l'homme avec ses semblables, il en est deux auxquelles l'homme en général et particulièrement l'homme des agglomérations urbaines, ne peut se soustraire sans occasionner de perturbations sociales.

La première est une loi morale qui ordonne à l'homme de "faciliter à son semblable la possession de tout ce qui peut être l'objet de ses propres besoins" (12).

Le seconde est une loi naturelle instinctive en vertu de laquelle "l'homme venant de la nature aspire à retourner à la nature".

Est-il besoin de décrire et d'énumérer ici les funestes conséquences que la dérogation à ces lois eût pour l'humanité, lorsque nous les subissons nous-mêmes aujourd'hui dans ce qu'elles ont de plus désastreux !

Qu' advient-il en effet de la vie économique lorsque l'homme, mû par l'impulsive pression de son intérêt personnel, s'affranchit, au détriment de l'intérêt collectif, de la loi qui refréne les instincts aveugles, pour s'élancer à la poursuite des moyens qu'il croit susceptibles de l'arracher à l'étreinte douloureuse de la lutte pour l'existence?

Qu' advient-il encore de l'organisme social lorsque l'ouvrier des villes industrielles doit y vivre dans des conditions défavorables au développement des forces physiques, morales et intellectuelles qui lui sont nécessaires pour accomplir un travail productif? (14)

Qu'advient-il enfin d'une nation lorsque le réservoir de ses forces vives ne suffit pas à alimenter les villes qui ne les absorbent que pour les consumer à la façon d'une lampe qui brûle à la fois sa mèche et son essence?

Les perturbations sociales actuelles ne nous l'apprennent que trop. Puissent du moins les salutaires leçons qui en découlent être profitables à l'homme en le ramenant au sens des réalité dont il s'était écarté, i.e., en l'incitant à conformer ses actes aux lois qui doivent les régir.

Voyons maintenant de quelle façon l'homme des agglomérations s'écarte de ces deux lois et jusqu'à quel point cet écart le rend malheureux.

S'il est un être civilisé qui vit dans un milieu social défavorable à son développement physique, moral et intellectuel, c'est bien sans contredit, l'ouvrier des agglomérations urbaines, bien qu'il soit le pivot sur

lequel repose l'équilibre social et économique. C'est lui qui fait, en effet, fructifier le capital en fouillant les entrailles de la terre, en captant et utilisant les forces naturelles, en transformant la matière brute, en établissant des moyens de transport, en faisant surgir des villes où il édifie des palais, et pourtant, ce puissant facteur du progrès, cet artisan du confort ne peut généralement pas se procurer, même à prix de sacrifices, l'espace qui lui serait nécessaire pour bénéficier de l'action tonique et vivifiante de l'air pur et des rayons de soleil dont son organisme ne saurait se passer pour accomplir normalement ses fonctions physiologiques !

N'est-ce-pas un fait avéré qu'il est réduit dans presque toutes les grandes agglomérations à vivre dans un entassement (15) qui constitue une dérogation à la loi naturelle, un danger pour sa santé physique, morale et intellectuelle, et une menace pour l'organisme social.

Est-il besoin de démontrer ici quel enchaînement de maux peuvent résulter de cet entassement pour l'individu lui-même, pour la famille, pour la société et pour la nation entière, lorsqu'il ne suffit à l'observateur que de visiter certains quartiers ouvriers et de pénétrer dans leurs habitations pour y découvrir un amoncellement de misères capables d'engendrer les pires ferments antisociaux? (16)

La vague d'anarchie qui déferle actuellement sur une partie de l'Europe et qui menace d'engloutir l'autre, ne provient-elle pas de l'écroulement des digues morales impuissantes à refouler l'affluence envahissante des flots de misères qui déversent des centres ouvriers?

Voudra-t-on prétendre que ces maux provenant de l'entassement sont le lot exclusif des pays surpeuplés des vieux continents, lorsque dans un jeune et vaste pays comme notre province où la densité démographique est de 4,820,175 pieds carrés par rapport à celle de la France qui est de 144,967 pieds carrés, par individu, nous en sommes déjà à résoudre d'urgence-en face de la marée montante des misères - le problème de l'habitation ouvrière dont on ne s'était guère préoccupé jusqu'ici?

La situation de fait étant nettement fixée, remontons-en maintenant aux causes.

Il est reconnu que l'ampleur du mou ment migratoire vers une ville corresp à l'intensité de la force attractive exercée son activité économique. Aussi devra-t- être construite d'après un plant d'extens susceptible de procurer aux individus l'habitent ou l'habiteront tout le confort toute la sécurité que supposent les lois de physiologie et que comportent les progrès la civilisation. (17).

Elle devra donc être aménagée de faco

1o—que son développement en surf puisse s'effectuer *sans entrave* proportionn lement à l'augmentation de sa population de son activité économique, et ce afin prévenir l'entassement.

2o—que l'orientation des rues, leur nc bre, leur largeur et la hauteur des édifi puissent permettre à la lumière directe soleil de pénétrer partout, aussi abonda ment et longtemps que possible.

3o—que la salubrité de l'air soit assurée sinon par des moyens artificiels (appare fumivores, arrosements, etc.) du moins— des moyens naturels (parcs, jardins, arbr étangs, squares, etc.) (18)

4o—que la circulation puisse s'y faire sa encombre et que les transports, les dépla ments et les communications intellectuel puissent être exécutés facilement et rapi ment.

5o—que l'approvisionnement d'eau pu soit assez considérable pour subvenir à tou les fins domestiques, industrielles, hygié ques et éventuelles.

6o—que l'assainissement en soit rendu p sible par un système de drainage du sol et rues, d'évacuation des ordures et déchets, a proprié aux besoins.

7o—que l'approvisionnement alimenta en soit facilité par l'établissement de hal spacieuses aux endroits les plus accessib tant aux consommateurs qu'aux producteu

De toutes les conditions essentiell d'aménagement rationnel des villes, la p mière est incontestablement la plus imp tante puisqu'elle prévient l'entassement q rendrait impossible la réalisation de la m jeure partie des autres.

Or, nos cités modernes sont-elles généra ment construites d'après un plan d'extensi susceptible d'aménagement rationnel? N'e il pas prouvé que leur déconcentration

ffectue pas proportionnellement à l'accroisnent de leur population et qu'elles souffnt d'un entassement dont nous avons déjà montré les terribles conséquences (19)?
A quoi tient-il donc que cela ne se fasse? Déduction faite des causes d'ordre géograique (géographie physique et historique) 0) qui ont pu et peuvent encore contribuer entraver le développement d'un certain mbre de villes, cela tient surtout à des uses humaines dont les principales sont *mprévoyance* et la *cupidité*.
Avons-nous besoin de tirer nos preuves n milieu étranger pour établir que l'imprévance fut et est encore cause de l'entassent, lorsque nous en avons à foison dans tre propre province?
Tout en tenant compte du fait que la plurt de nos villes étaient dans l'origine des urgs fermés construits de facon à tirer ofit des avantages naturels de défense - dont le beau désordre dans la disposition s habitations présentait un aspect plutôt ttoresque que sanitaire - ne conviendra-t-pas qu'elles se sont graduellement agrandes par la suite suivant le prolongement des ies publiques alors existantes et non après un plan préconçu en vue de faciliter ir aménagement futur?
Et parce que les administrateurs d'alors ne rent pas prévoir tout le développement en rface que prendraient, avec le temps, leurs lles respectives, et prévenir par un meilir aménagement l'entassement dont elles uffrent aujourd'hui, s'ensuit-il que nos rps municipaux actuels doivent eux-mêmes nquer de prévoyance en permettant qu'elles ntinuent de se développer d'après le plan extension des villes massives (21) aurd'hui reconnu pour irrationnel par les onomistes les plus réputés?
Est-ce trop encourir le risque de blesser s susceptibilités et d'être taxé d'ingérence empestive que d'affirmer que les sommes menses que l'on se propose d'affecter à mélioration de l'habitation ouvrière de nos les, ne seront que des palliatifs, à moins 'on ne se préoccupe au préalable de remaer leur plan d'extension actuel selon le incipe des villes concentriques (22).
S'imagine-t-on en effet supprimer la use en remédiant aux effets?
A-t-on réussi à enrayer la marche de ce ancre, qu'est l'entassement, qui ronge certaines villes anglaises et américaines en y expropriant et démolissant nombre de quartiers malsains pour y reconstruire quelques milliers d'habitations dites hygiéniques, ou si l'on n'a fait qu'anesthésier et désinfecter la plaie?

Instruits que nous sommes des maux sans nombre qu'engendre déja l'entassement dans nos villes à peine naissantes, mais appelées par leur situation géographique à devenir des agglomérations considérables, seronsnous justifiables auprès des générations à venir de n'avoir pas démoli - pendant qu'il en était encore temps - les cadres étroits qui se resserrent sur nous et où elles seront enserrées comme dans des étaux?

S'il est vrai que "le civilisé pense dans l'avenir" et que notre imprévoyance doive être cause des malheurs des générations futures, celles-ci n'auront certes pas lieu de se glorifier du degré de civilisation de leurs ancêtres !

A supposer par ailleurs qu'une évolution profonde fut en voie de se produire qui aurait pour résultat de dégager l'ouvrier urbain de l'infect milieu artificiel où il doit vivre et de le rapprocher davantage de la nature, pourrait-elle parcourir sans achopper le cycle tracé par les mesures les plus prévoyantes, si des mesures énergiques n'étaient simultanément prises en vue de refréner la cupidité qui préside à la plus-value foncière.

Et d'abord, pourrait-on contester que l'insatiable cupidité humaine ne soit pas cause de cette plus-value foncière qui contribue, à l'égal de l'imprévoyance, à entraver le développement en surface des villes, à renchérir la superficie locative et, partant, à provoquer l'entassement.

Ne suffirait-il pas, pour le prouver, d'évoquer la crise financière qui survînt au début de la dernière décade, à la suite de l'engloutissement impétueux des capitaux dans l'accaparement inconsidéré de la propriété foncière attenant aux villes.

Après une course aussi furibonde dont le mobile était la cupidité, ne serait-ce pas fermer les yeux à l'évidence que de refuser à voir en elle un obstacle formidable à la réalisation d'un plan d'aménagement rationnel de nos villes ?

Que les conditions défavorables du milieu physique en soient l'occasion matérielle,

nous ne saurions le contester; mais il n'est pas moins vrai qu'il est au pouvoir de l'homme de résister comme de céder à son entraînement.

Quels que soient donc les efforts de ceux qui s'évertuent à dissimuler cette cupidité dont ils sont dévorés en l'affublant des vocables fashionables de transactions commerciales et de questions économiques, elle ne saurait manquer d'être tôt dépouillée de ces embellissements postiches par ceux qui en sont ou seront les victimes et d'apparaître alors dans toute sa hideuse nudité.

Eh quoi! parce que la concurrence est la force régulatrice de l'activité économique et que les citadins doivent la subir dans les secteurs où elle s'exerce davantage (23), s'ensuit-il que les pouvoirs municipaux doivent en laisser le contrôle aux mains de ceux qui trouvent profits personnels à l'étendre aux endroits où elle ne s'exerce pas immédiate, en vue de l'exploiter ensuite au détriment de l'intérêt collectif?

Est-ce bien dans l'intérêt commun des citadins qu'une ville consente tacitement à se laisser enserrer par les tentacules des parasites sociaux qui épient toute perspective de développement ou d'annexion pour mieux étreindre, par la plus-value factice qu'ils donnent à la propriété foncière, le gousset de ceux qui s'en porteront acquéreurs ?

Peut-on rétorquer sérieusement que cette plus-value exagérée est en réalité plus favorable que nuisibile au développement d'une ville, sous prétexte que les taxes qu'elle perçoit, augmenteront dans le même proportion et que, partant, elle sera plus en mesure d'entreprendre des améliorations utiles?

Autant voudrait dire alors: périssent les citadins plutôt qu'un impôt tout comme si les citadins étaient faits pour les impôts et non les impôts pour les citadins !

Voilà en effet, les tenants et aboutissants du civilisé qui croit devoir substituer l'égoisme à altruisme pour s'affranchir du joug des conditions défavorables d'existence.

Qu'on aille maintenant lui proposer comme remède à l'entassement, la municipalisation des terrains adjacents aux quartiers excentriques des villes !

* * *

Il appert de ce qui précède que l'homme souffre beaucoup plus des conditions défavorables du milieu social que de celles du lieu physique, tout compte tenu de la relation qui existe entre elles (24).

Que l'homme qui est né pour produire qui est par excellence un être social, poss en lui-même - à l'état de puissance - les ments du bonheur relatif auquel il aspire

Qu'il ne peut cependant réaliser ce h heur que par un déploiement d'efforts (correspondant à l'intensité de ses bes (26) et conformes aux lois naturelles morales qui les régissent.

RENVOIS.

1. Paul LeRoy-Beaulieu, Précis d'éco mie politique, page 441.
2. "La grande agglomération urbaine une agglomération malade." (Co d'Haussonville, après Brunhes, "Géog phie humaine, p. 585).
3. "Tandis que les êtres humains sembl de plus en plus massés les uns cor les autres, ils sont en réalité de plus plus séparés les uns des autres par exigences mêmes de la géographie ciale des grandes villes." (id. p. 58
4. "L'homme est en grande partie le p duit du milieu physique dans leque est placé". (Edmond Villey, Princi d'économie politique, p. 61).
5. "L'occasion matérielle de cette perv sion morale est le manque de ressour naturelles, l'inadaptation du globe la loi de la population, à la multipl tion des espèces animales et végétale à l'entretien de la vie". (Renouv "Le Personnalisme", après Chan. B tes dans "L'Univers et la vie", p. 64
6. "C'est cette tendance à se libérer du n la *vix medicatrix naturae*, et qui a jours poussé les hommes à amélio leur condition sociale". (J. Novic "Le bonheur des sociétés humaines". Revue, 15 oct. 1905).
7. V.g: Lutte entre ses instincts et sa son.
8. "Les besoins développent la civilisat et la civilisation développe les beso Elle donne à l'homme, en effet, pouvoir de plus en plus accru de sa faire ses besoins avec un effort moind et les besoins se multiplient à mes qu'ils sont satisfaits". (Ed. Villey, c. p. 35).

Chanoine Brettes, "L'Univers et la vie". p. 562).

En effet, étant donné d'une part que ces activités sont engendrées par l'énergie de l'homme sous l'impulsion de ses instincts et la pression de ses besoins, et que d'autre part, elles sont régies par des lois économiques et morales auxquelles celui-ci est libre d'obéir ou de déroger, il s'ensuit que sa vie économique subira des modifications variables qui seront favorables ou défavorables à son amélioration suivant qu'il cédera ou résistera à ses instincts, qu'il satisfera ou restreindra ses besoins.

"Les instincts de l'homme le poussent à agir pour lui et dans son intérêt personnel". (Ed. Villey, L.C., p. 41).

N'est-ce-pas là le précepte: "Fais à autrui ce que tu voudrais qu'on te fît à toi-même".

"L'énergie, l'habilité et la durée sont les conditions générales de productivité du travail". (Paul Beauregard, "Eléments d'économie politique", p. 46).

"Nos cités modernes, surtout les plus populeuses et celles qui sont le plus rapidement progressives, sont en perpétuelle contravention avec les règles de l'hygiène et, sans entrer ici dans les détails qui relèvent des études des spécialistes, le grand mal des villes peut se résumer d'un mot: c'est l'entassement". (Chs. Brouilhet, "Précis d'économie politique", p. 319).

"Les citadins se résignent tranquillement à vivre de plus en plus dans l'obscurité. En examinant les conditions moyennes des logements dans une ville des pays tempérés, on peut affirmer que le tiers supérieur des surfaces des étages, déjà si encombré, est insuffisamment éclairé, le second tiers l'est mal; quant au tiers inférieur, il se trouve presque plongé dans une obscurité complète. Que l'on se transporte dans certains quartiers de grandes agglomérations urbaines, et l'on sera édifié sur leurs conditions hygiéniques en voyant ces cours étroites et fermées, ces courettes immondes où des populations entières cherchent à vivre tant bien que mal, presque sans air et sans lumière. Que dire de la salubrité des chambres qui s'ouvrent sur ces espaces obscurs appelés cours fermées où près des deux tiers des citadins de certaines villes vivent entassés." (Cosmos, 10 juil, 1913, p. 30).

17. "On peut résumer les désiderata auxquels ces cités doivent satisfaire en disant qu'elles doivent être commodes, hygiéniques et esthétiques". (Chs, Brouilhet, L.c. p. 316).

18. "Le principal de nos revendications porte sur la création d'espaces libres. Le seul espace libre de nos cités, c'est la rue, moyen elle-même de circulation et déjà insuffisante comme telle. Mais la rue ne suffit pas à la respiration des cités: celle-ci ne peut être assurée que par les avenues larges et plantées d'arbres, par les places spacieuses, les pares, les squares et les cours intéricures des immeubles." (Id. p. 320).

19. "Le minimum d'un logement pour une famille avec des enfants devrait être de 4 pièces: 1 pour les parents, 2 pour les enfants afin de séparer les sexes, 1 pour la cuisine, salle à manger, vie de famille. Il n'y a certes rien de trop. On compte à Paris 228500 ménages de 4 personnes et au delà, riches ou pauvres; sur ce nombre il n'y en a que 88000 qui occupent des logements de 4 pièces et plus: or, nul doute que ces privilégiés appartiennent presque tous à la classe bourgeoise." (Charles Gide, "Les institutions de progrès social". p. 244).

"La statistique municipale de Paris nous révèle qy'il y a 102,000 ménages n'ayant pour tout logenent qu'une seule chambre. Pour les ménages qui ne se composent que de 2 personnes, passe encore! mais sur ce chiffre il y en a 24500 qui sont des familles de 3 personnes au moins et plus de 10500 qui en comptent 4, 5, 6 et jusqu'à 12 ou 15! Et parfois même ce ne sont pas les membres d'une même famille, mais des sous-locataires ou pensionnaires." (Id. p. 243).

20. V.-g. Enceinte resserrée soit par la configuration des lieux (géographie physi-

que) soit par des fortifications, etc. (géographie historique).

21. "Des parties neuves aux parties anciennes de l'agglomération, les contacts sont souvent mal établis et la circulation mal assurée, et nous voyons aisément l'erreur géographique commise par la construction en damier que nos pères considéraient encore comme un progrès. Elle est irrationnelle et cela ressortira mieux encore de la comparaison qu'on peut établir entre elle et d'autres principes d'aménagement projétés." (Chs. Brouilhet, L.c., p. 331).

22. "Les villes concentriques donneraient aux citadins l'élasticité et l'emplacement". (Chs. Brouilhet. L.c., p. 335). "Elles ont un centre duquel divergent des avenues spacieuses permettant à la population un mouvement de va-et-vient entre le coeur de la ville et sa périphérie, celle-ci s'éloignant progressivement avec l'accroissement de la ville. Les sections formées par les avenues sont divisées régulièrement par des boulevards circulaires qui permettent communications de quartier en tier". (Id. p. 333).

23. "C'est dans le secteur privilégié ville que doivent et veulent être ceux qui dépendent de l'afflux du blic indéterminé, de l'homme de la suivant l'expression anglaise, depui théâtres et les banques jusqu'au merce de détail et aux cafés". Brouilhet, L.c., p. 323).

24. "Entre le facteur naturel constant facteur humain variable, le rappo sans cesse se transformant". ("Géo phie humaine", Brunhes, p. 729).

25. "Comme la vie est dans l'action, qui cesse d'agir semble aussi avoir de vivre". (Bossuet).

26. "Ainsi, on peut l'affirmer hardi l'aptitude de l'homme à ressentir besoins avec assez de force pour son instinct de paresse et d'ina soit vaincu, est la seule condition e tielle de progrès. (Paul Beaure L.c., p. 47).

Third Annual Convention, C.S.T.A.

DATES—JUNE 20th to 23rd, 1923. PLACE—University of Saskatchewan, Saska

The final Convention programme will be printed in the next issue. The General Secretary of the Society is working in close cooperation with local committees in Saskatchewan, and no detail will be overlooked.

Through the financial assistance of the Dominion Department of Agriculture a series of advanced lectures will be given in Soils, Forage Crops, Cereal Crops and Economics.

Business sessions of the greatest importance and interest will occupy three morning sessions.

A substantial fund for Entertainment been provided by the Saskatchewan De ment of Agriculture.

There will be a Provincial Governm Banquet, a University Banquet and Da visits to the Dominion Forestry Statio Sutherland and the Experimental Far Rosthern, a Stock Show, and many features.

Every member should do his utmost t present. Resolutions, etc., which shoul brought before the Convention, must the General Secretary before May 20th.

Determinations of the Dressed, Drawn and Edible Percentages of Various Kinds of Domestic Birds.

By M. A. JULL and W. A. MAW,

Macdonald College, P.Q.

The main object in the growing and preration for market of any class of domestic rd, should be to produce as high a proporn as possible of edible substance in relan to the total live weight. The advantages properly fattening birds for market has en demonstrated by the results of various periments and need not be referred to here. the other hand, very few determinations ve been made concerning the dressing, awing or edible percentages of any of the merous kinds of domestic birds. The writs have made a number of these determinans, the results of which are presented in e three parts of this paper.

In each case the probable error of the ean has been determined and, also, the proble errors of the standard deviation and of e coefficient of variability. In this connecn it should be pointed out that the numrs involved, on which the various calcutions have been based, are rather small, d too great significance should not be atched to the results. Moreover, since the dinary formulas have been used in makg the calculations, the results may appear ghtly more significant than is really the case, due to the small numbers involved. At the same time, the extremely uniform results throughout the entire series of determinations would suggest that a considerable degree of reliability might be attached to the determinations made.

1. Determinations of the Dressed and Drawn Percentages of Fattened Roasters.

The results are given in tabular form, and but little discussion seems necessary. Table I gives the percentages of blood, feathers and dressed weight in six groups of roasters which were fattened for a period of two weeks. The roasters were practically of the same age and were composed of Barred Plymouth Rocks and Rhode Island Reds, with no differentiation being made with respect to breed, since the breeds were fattened together. When placed in the fattening crates the birds were selected according to age and development, so that each group of birds was quite uniform. It will be seen that in the case of fattened roasters averaging 4.99 lbs. each live weight the percentage of blood was 4.01 ± .19 and of feathers 7.01 ± .27, giving a dressed weight of 88.98 ± .22.

TABLE I—SHOWING THE DRESSING PERCENTAGE IN FATTENED ROASTERS

roup	No. Birds	Aver. Weight per Bird in Lbs.				Per Cent of Live Weight		
		Live	Blood	Feathers	Dressed	Blood	Feathers	Dressed
I	42	5.05	0.21	0.31	4.53	4.21	6.19	89.57
II	54	5.24	0.23	0.39	4.62	4.39	7.46	88.15
III.	18	5.90	0.19	0.46	5.25	3.22	7.05	88.95
IV	6	5.25	0.19	0.46	4.60	3.43	8.72	87.69
V	27	4.35	0.17	0.31	3.87	3.86	7.05	89.06
VI	18	4.10	0.19	0.24	3.67	4.56	5.76	89.65
tal	165	4.99	0.20	0.35	4.44	4.01±.19	7.01±.27	88.98±.22
Standard Deviation						0.68±.13	1.00±.19	0.82±.16
Coefficient of Variability						16.96±3.30	14.26±2.78	0.92±.18

Lee (1911) reports a dressing percentage of 85.3 in roasters and 7.9 in springs. Stoneburn (1906) reports a dressing percentage of 89.0 in cockerels, 90.9 in Barred Plymouth Rocks and 89.3 in Rhode Island Reds, presumably fattened roasters. Mairs (1908) reports that in Barred Plymouth Rock cockerels the percentage of blood was 4.02, of feathers 8.36, and a dressing percentage of 87.62. All of these results, together with those published in this paper are quite u form.

Tables II and III give the drawn perce ages respectively on the dressed weights a group each of small, from 3.00 to 4.00 l each, and large, from 4.50 to 5.50 lbs. ea roasters. The offal includes the head, f and viscera. The remainder of the bi including the heart, liver and gizzard, c stitutes the drawn bird. Both groups

TABLE II SHOWING THE DRAWN PERCENTAGE IN SMALL FATTENED ROASTERS

No.	Aver. Wt. per Bird in Lbs.			Per Cent Drawn of Dressed Weight
	Dressed	Offal	Drawn	
1	3.00	0.81	2.19	73.00
2	3.31	0.90	2.41	72.81
3	3.62	0.98	2.64	72.93
4	3.25	0.80	2.45	75.38
5	3.62	0.91	2.71	74.86
6	3.00	0.75	2.25	75.00
7	3.87	0.82	3.05	78.81
8	3.37	0.83	2.54	75.37
9	3.94	0.80	3.14	79.69
10	3.25	0.71	2.54	78.15
11	3.09	0.72	2.37	76.70
12	3.01	0.69	2.32	77.07
13	3.00	0.73	2.27	75.67
14	3.09	0.73	2.36	76.38
15	3.37	0.77	2.60	77.15
16	3.25	0.75	2.50	76.92
17	3.12	0.69	2.43	77.88
18	3.00	0.64	2.36	78.67
19	3.03	0.71	2.32	76.57
20	3.18	0.76	2.42	76.10
Total	65.37	15.50	49.87	....
Aver.	3.27	0.77	2.50	76.28±.27
Standard Deviation				1.80±.19
Coefficient of Variability				2.36±.25

TABLE III SHOWING THE DRAWN PE CENTAGE IN LARGE FATTENED ROASTERS

No.	Aver. Wt. per Bird in Lbs.			Per Cen Drawn Dressed Weight
	Dressed	Offal	Drawn	
1	5.50	1.15	4.35	79.09
2	5.06	1.06	4.00	79.05
3	4.75	1.12	3.63	76.42
4	4.87	1.03	3.84	78.85
5	5.50	1.26	4.24	77.09
6	5.00	1.13	3.87	77.40
7	4.87	1.10	3.77	77.41
8	4.62	1.12	3.50	75.75
9	5.00	1.05	3.95	79.00
10	4.94	1.15	3.79	76.72
11	5.44	1.30	4.14	76.10
12	5.00	1.18	3.82	76.40
13	5.00	1.13	3.87	77.40
14	4.75	1.12	3.63	76.42
15	4.75	1.15	3.60	75.79
16	5.50	1.23	4.37	79.45
17	5.37	1.21	4.16	77.47
18	4.87	1.13	3.74	76.80
19	5.00	1.19	3.81	76.20
20	4.87	1.10	3.77	77.41
Total	100.66	22.91	77.85	....
Aver.	5.03	1.14	3.89	77.33±
Standard Deviation				1.14±
Coefficient of Variability				1.47±

birds give practically the same results, 76.28 ± .27 and 77.33 ± .17, the difference with its probable error, 1.05 ± .32, being barely significant.

II. Determinations of the Dressed and Edible Percentages of Various kinds of Chickens.

In this section of the paper are presented the results of determinations of the percentage of dressed of the live weight and of the percentages of edible of the dressed and the live weights respectively in unfattened and fattened broilers, unfattened and fattened roasters, fattened capons and fattened hens. The broilers were White Leghorns and the others Barred Plymouth Rocks and Rhode Island Reds. Dressed birds, as in Part I, are birds with the blood and feathers removed. The offal includes the head, feet, viscera and the bones of the body. The process of boning has been thoroughly described by Lippincott, (1916, pp. 456 - 463). After the bird is boned, the flesh plus the heart, liver and gizzard, represents the edible portion.

One object was to determine the possible advantages, both to producer and consumer, of fattening broilers and roasters. Another object was to compare the dressing and edible percentages of the various kinds of fattened chickens.

A summary of the results is shown in Table VII and the edible percentages of the dressed and live weights respectively are shown in Figures 1 and 2. The dressing percentage is greatest in fattened hens, then fattened capons, then fattened roasters, then fattened broilers, while unfattened roasters and unfattened broilers are lowest. The differences, with their probable errors, between unfattened and fattened broilers and between unfattened and fattened roasters, are slightly significant in each case, but the differences, with their probable errors, between fattened roasters and fattened capons and between fattened capons and fattened hens, are not significant.

Lee (1911) reports a dressing percentage of 85.6 in hens and 85.7 in broilers, while Stoneburn (1906) reports a dressing percentage of 92.3 in hens, which is almost exactly the same as that reported in this paper.

In respect to the edible percentages of the dressed weight, the differences, with their probable errors, are significant in every case. Such is to be expected in the case of unfattened compared with fattened broilers as well as in the case of unfattened compared with fattened roasters. Concerning the value of the edible percentages of the dressed weights, the various kinds of chickens take the following order: Fattened capons, fattened hens, fattened roasters, fattened broilers, unfattened roasters, unfattened broilers.

TALBE I—SHOWING DRESSING AND EDIBLE PERCENTAGES IN UNFATTENED BROILERS

No.	Average Weight per Bird in Pounds					Per Cent Dressed of Live Weight	Per Cent Edible of Dressed Weight	Per Cent Edible of Live Weight
	Live	Blood and Feathers	Dressed	Offal	Edible			
1	2.75	0.25	2.50	1.22	1.28	90.91	51.20	46.54
2	2.31	0.25	2.06	0.97	1.09	89.18	52.91	47.19
3	2.59	0.37	2.22	1.00	1.22	85.71	54.95	47.10
4	2.16	0.32	1.84	0.84	1.00	85.18	54.35	46.29
5	3.44	0.38	3.06	1.31	1.75	88.95	57.19	50.87
Total	13.25	1.57	11.68	5.34	6.43			
Aver.	2.65	0.31	2.34	1.07	1.27	88.30±.72	54.27±.60	47.92±.50
Standard Deviation						2.40±.51	2.00±.42	1.67±.35
Coefficient of Variability						2.72±.58	3.64±.77	3.46±.74

TABLE II—SHOWING DRESSING AND EDIBLE PERCENTAGES IN FATTENED BROILER

No.	Average Weight per Bird in Pounds					Per Cent Dressed of Live Weight	Per Cent Edible of Dressed Weight	Per Cent Edible of Live Weight
	Live	Blood and Feathers	Dressed	Offal	Edible			
1	3.12	0.25	2.87	1.09	1.78	91.99	62.02	57.05
2	2.56	0.25	2.31	0.94	1.37	90.23	59.31	53.51
3	2.87	0.28	2.59	1.00	1.59	90.24	61.39	55.40
4	2.50	0.25	2.25	0.88	1.37	90.00	60.89	54.80
5	2.56	0.25	2.31	0.94	1.37	90.23	59.31	53.51
Total	13.61	1.28	12.33	4.85	7.48	....	....	....
Aver.	2.72	0.26	2.47	0.97	1.50	90.81±.38	60.73±.24	55.15±.55
Standard Deviation						1.26±.27	0.81±.17	1.83±.38
Coefficient of Variability						1.38±.29	1.33±.28	3.31±.70

TABLE III—SHOWING DRESSING AND EDIBLE PERCENTAGES IN UNFATTENED ROASTERS

No.	Average Weight per Bird in Pounds					Per Cent Dressed of Live Weight	Per Cent Edible of Dressed Weight	Per Cent Edible of Live Weight
	Live	Blood and Feathers	Dressed	Offal	Edible			
1	4.31	0.56	3.75	1.68	2.07	87.01	55.20	48.03
2	4.09	0.49	3.60	1.53	2.07	88.02	57.50	50.61
3	3.84	0.59	3.25	1.34	1.91	84 63	58.77	49.74
4	3.56	0.50	3.06	1.34	1.72	85.95	56.21	48.31
5	4.37	0.43	3.94	1.78	2.16	90.16	54.82	49.43
6	4.44	0.44	4.00	1.63	2.37	90.09	59.25	53.38
7	4.62	0.49	4.13	1.54	2.59	89.39	62.71	56.06
8	5.34	0.48	4.86	2.15	2.71	91.01	55.76	50.75
9	4.37	0.49	3.88	1.77	2.11	88.79	54.38	48.28
10	5.31	0.44	4.87	2.21	2.66	91.71	54.62	50.09
Total	44.25	4.91	39.34	16.97	22.37	....	....	....
Aver.	4.42	0.49	3.93	1.70	2.24	88.90±.45	56.86±.53	50.55±.54
Standard Deviation						2.10±.32	2.51±.38	2.53±.38
Coefficient of Variability						2.36±.35	4.41±.66	4.99±.75

Concerning the edible percentages of the ve weights, the same situation prevails as or edible percentages of the dressed weights. attened capons, averaging 7.72 lbs. each live eight, are shown to have an edible percentge of 62.05 ± .33; fattened hens, averaging .77 lbs. each live weight, are shown to have n edible percentage of 59.09 ± .87; fattend roasters, averaging 6.25 lbs. each live eight, are shown to have an edible percentage of 57.84 ± .38; fattened broilers, averaging 2.72 lbs. each live weight, are shown to have an edible percentage of 55.15 ± .55; unfattened roasters, averaging 4.42 lbs. each live weight are shown to have an edible percentage of 50.55 ± .54; unfattened broilers averaging 2.65 lbs. each live weight, are shown to have an edible percentage of 47.92 ± .50.

ABLE IV—SHOWING DRESSING AND EDIBLE PERCENTAGES IN FATTENED ROASTERS

No.	Average Weight per Bird in Pounds					Per Cent Dressed of Live Weight	Per Cent Edible of Dressed Weight	Per Cent Edible of Live Weight
	Live	Blood and Feathers	Dressed	Offal	Edible			
1	6.44	0.63	5.81	2.05	3.76	90.22	64.72	58.38
2	6.81	0.62	6.19	2.17	4.02	90.89	64.94	59.03
3	6.34	0.53	5.81	2.00	3.81	91.64	65.58	60.09
4	5.06	0.64	4.62	1.83	2.79	91.30	60.39	55.14
5	6.94	0.63	6.31	2.23	4.08	90.92	64.66	58.79
6	6.00	0.50	5.50	2.20	3.30	91.67	60.00	55.00
7	6.37	0.50	5.87	2.29	3.58	92.15	60.99	56.36
8	6.94	0.56	6.38	2.46	3.92	91.93	61.44	56.48
9	5.78	0.41	5.37	1.94	3.43	92.91	63.87	59.34
10	5.87	0.37	5.50	2.01	3.49	93.70	63.45	59.45
otal	62.55	5.19	57.36	21.18	36.18	....	....	....
ver.	6.25	0.52	5.74	2.12	3.62	91.70±.17	63.07±.43	57.84±.38
Standard Deviation						0.89±.13	2.30±.35	1.79±.27
Coefficient of Variability						0.97±.15	3.65±.55	3.09±.46

TABLE V—SHOWING DRESSING AND EDIBLE PERCENTAGES IN FATTENED CAPONS

No.	Average Weight per Bird in Pounds					Per Cent Dressed of Live Weight	Per Cent Edible of Dressed Weight	Per Cent Edible of Live Weight
	Live	Blood and Feathers	Dressed	Offal	Edible			
1	7.56	0.50	7.06	2.50	4.56	93.39	64.59	60.32
2	7.81	0.60	7.31	2.30	5.01	93.59	68.54	64.15
3	8.12	0.50	7.62	2.31	5.31	93.89	69.68	65.39
4	7.19	0.75	6.44	2.19	4.25	89.57	65.99	59.11
5	8.44	0.76	7.68	2.55	5.13	90.99	66.79	60.78
6	8.19	0.69	7.50	2.31	5.19	91.57	69.20	63.36
7	6.81	0.62	6.19	1.99	4.20	90.89	67.85	61.67
8	7.19	0.63	6.56	2.14	4.42	91.24	67.38	61.47
9	7.37	0.62	6.75	2.20	4.55	91.59	67.41	61.74
10	8.50	0.63	7.87	2.60	5.27	92.59	66.96	62.00
Total	77.18	6.20	70.98	23.09	47.89	....	....	....
Aver.	7.72	0.62	7.10	2.31	4.79	91.97±.28	67.46±.30	62.05±.33
Standard Deviation						1.30±.19	1.39±.21	1.54±.23
Coefficient of Variability						1.41±.21	2.06±.31	2.48±.37

TABLE VI—SHOWING DRESSING AND EDIBLE PERCENTAGES IN FATTENED HENS

No.	Average Weight per Bird in Pounds					Per Cent Dressed of Live Weight	Per Cent Edible of Dressed Weight	Per Cent Edible of Live Weight
	Live	Blood and Feathers	Dressed	Offal	Edible			
1	4.50	0.38	4.12	1.62	2.50	91.55	60.68	55.55
2	5.41	0.41	5.00	1.62	3.38	92.42	67.60	62.48
3	5.50	0.44	5.06	1.82	3.24	92.00	64.03	58.91
4	5.69	0.44	5.25	1.75	3.50	92.27	66.67	61.51
5	6.19	0.41	5.78	2.20	3.58	93.38	61.94	57.83
6	6.81	0.56	6.25	2.66	3.59	91.78	57.44	52.72
7	5.41	0.41	5.00	1.72	3.28	92.42	65.60	60.63
8	4.37	0.49	3.88	1.59	2.29	88.79	59.02	52.40
9	6.72	0.47	6.25	1.91	4.34	93.00	69.44	64.58
10	7.06	0.50	6.56	2.11	4.45	92.92	67.83	63 03
Total	57.66	4.51	53.15	19.00	34.15	....	....	....
Aver.	5.77	0.45	5.31	1.90	3.41	92.03±.24	64.22±.75	59.09±.8
Standard Deviation						1.13±.17	3.51±.53	4.08±.6
Coefficient of Variability						1.23±.18	5.46±.82	6.90±1.

TABLE VII—COMPARISON OF DRESSING AND EDIBLE PERCENTAGES IN VARIOUS KINDS OF CHICKENS

	Per Cent Dressed of Live Weight		Per Cent Edible of Dressed Weight		Per Cent Edible of Live Weight	
	Mean	Difference	Mean	Difference	Mean	Difference
nfattened Broilers	88.30±.72	2.51±.81	54.27±.60	6.46±.64	47.92±.50	7.23±.62
attened Broilers	90.81±.38		60.73±.24		55.15±.38	
nfattened Roasters	88.90±.45	2.80±.58	56.86±.53	6.21±.53	50.55±.54	7.29±.66
attened Roasters	91.70±.17		63.07±.43		57.84±.38	
attened Capons	91.97±.28	0.27±.31	67.46±.30	4.39±.52	62.05±.33	4.21±.50
attened Hens	92.03±.24	0.06±.35	64.22±.75	3.24±.81	59.09±.61	2.96±.69

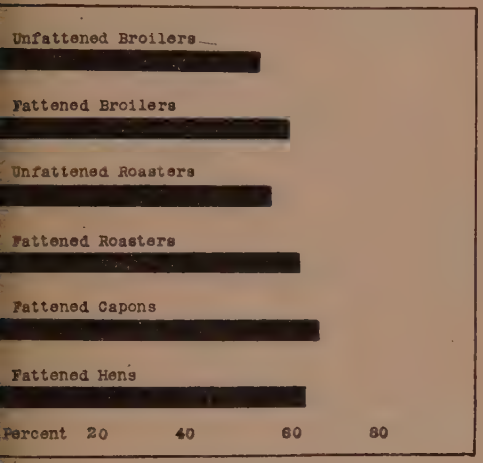


Fig. 1 - Showing Edible Percentages of Dressed Weight

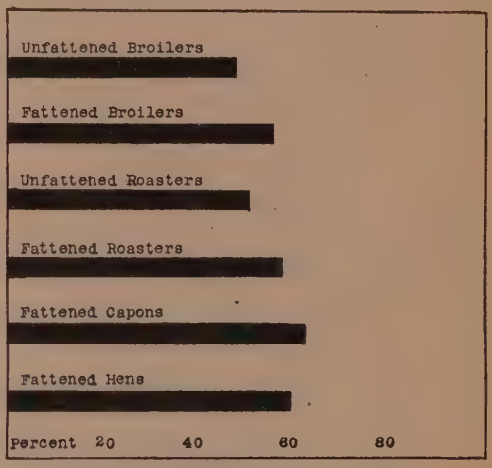


Fig. 2 - Showing Edible Percentages of Live Weight.

II. Determinations of the Dressing and Edible Percentages in Squab Guineas and Squab Pigeons and of the Edible Percentages of the Dressed Weight in Ducks, Geese and Turkeys.

In this section of the paper are shown the esults of determinations of the dressing and dible percentages in squab guineas and quab pigeons and the edible percentages of e dressed weight in ducks, geese and tur-eys. All of the birds were fattened, and the case of the guineas and pigeons the eterminations were made on birds of the me age. In the case of ducks, geese and rkeys, a number of the birds were purchased as dressed birds, so that no attention was paid to age. In some cases, the variation in the dressed weight was considerable, although the edible percentages are remarkably uniform.

Tables I and II show that the dressing percentage in squab guineas and squab pigeons is almost the same, 82.52±.47 and 82.08±.32. Remarkable differences are shown, however, in respect to the edible percentages of dressed weights, 60.25±.47 in squab guineas and 73.94±.45 in squab pigeons. This difference, illustrated in Figure I, with its probable error is 13.69±.53, making it quite significant. The edible percentages of the live weights are also quite different, 49.72 ± .33 and

(Text concluded on p. 338).

TABLE I—SHOWING DRESSING AND EDIBLE PERCENTAGES IN SQUAB GUINEAS

No.	Average Weight per Bird in Pounds					Per Cent Dressed of Live Weight	Per Cent Edible of Dressed Weight	Per Cent Edible of Live Weight
	Live	Blood and Feathers	Dressed	Offal	Edible			
1	1.94	0.39	1.55	0.58	0.97	79.90	62.58	50.00
2	2.06	0.41	1.65	0.66	0.99	80.10	60.00	48.06
3	2.25	0.38	1.87	0.73	1.14	83.11	60.96	50.67
4	2.12	0.29	1.83	0.75	1.08	86.32	59.01	50.94
5	1.94	0.40	1.54	0.64	0.90	79.38	58.44	46.39
6	2.56	0.40	2.16	0.87	1.29	84.37	59.72	50.39
7	2.87	0.48	2.39	0.91	1.48	83.27	61.92	51.57
8	2.87	0.50	2.37	0.92	1.45	82.58	61.18	50.52
9	2.37	0.45	1.92	0.79	1.13	81.01	58.85	47.68
10	2.19	0.35	1.84	0.75	1.09	84.01	59.24	49.77
Total	23.17	4.05	19.12	7.60	11.52	....	....	....
Aver.	2.32	0.40	1.91	0.76	1.15	82.52±.47	60.25±.29	49.72±.3
Standard Deviation						2.22±.33	1.34±.20	1.57±.2
Coefficient of Variability						2.69±.40	2.22±.33	3.16±.4

TABLE II—SHOWING DRESSING AND EDIBLE PERCENTAGES IN SQUAB PIGEONS

No.	Average Weight per Bird in Ounces					Per Cent Dressed of Live Weight	Per Cent Edible of Dressed Weight	Per Cent Edibl of Live Weight
	Live	Blood and Feathers	Dressed	Offal	Edible			
1	13.07	2.50	10.57	2.52	8.05	80.87	76.16	61.59
2	14.53	2.73	11.80	3.18	8.62	81.21	73.05	59.32
3	13.00	2.50	10.50	2.42	8.08	80.76	76.95	62.15
4	15.25	2.30	12.95	3.30	9.65	84.91	74.52	63.28
5	11.54	2.20	9.34	2.77	6.57	80.93	70.34	56.93
6	13.52	2.50	11.02	2.86	8.16	81.51	74.04	60.35
7	15.45	2.60	12.85	3.70	9.15	83.17	71.21	59.22
8	13.06	2.60	10.46	2.49	7.97	80.09	76.19	61.03
9	14.13	2.20	11.93	3.26	8.67	84.43	72.67	61.36
10	14.08	2.53	11.55	2.98	8.57	82.03	74.20	60.87
Total	137.63	24.66	112.97	29.48	83.49	....	....	....
Aver.	13.76	2.47	11.30	2.95	8.35	82.08±.32	73.94±.45	60.66±.3
Standard Deviation						1.51±.23	2.12±.32	1.73±.2
Coefficient of Variability						1.84±.28	2.87±.43	2.85±.4

ABLE III SHOWING EDIBLE PERCENTAGE OF DRESSED WEIGHT IN DUCKS

No.	Aver. Wt. per Bird in Lbs.			Per Cent Edible of Dressed Weight
	Dressed	Offal	Edible	
1	5.62	2.09	3.53	62 81
2	5.31	1.98	3.33	62.71
3	5.00	1 89	3.11	62.20
4	5.56	2.12	3.44	61.87
5	6.72	2.80	3.92	58.33
6	4.89	2.00	2 89	59.10
7	5.25	2.07	3.18	60.57
8	4.62	2.02	2.60	56.28
9	4.62	1.91	2.71	58.66
10	4.16	1.71	2.45	58.89
tal	51.75	20.59	31.16	....
er.	5.17	2.06	3.12	60.17±1.10
Standard Deviation				5.19±0.78
Coefficient of Variability				8.62±1.30

ABLE IV SHOWING EDIBLE PERCENTAGE OF DRESSED WEIGHT IN GEESE

No.	Aver. Wt. per Bird in Lbs.			Per Cent Edible of Dressed Weight
	Dressed	Offal	Edible	
1	11.19	4.10	7.09	63.36
2	14.66	4.78	9.88	67.39
3*	11.62	3.62	8.00	68.84
4*	11.25	3.69	7.56	67.20
5*	7.94	3.00	4.94	62.21
tal	56.66	19.79	36.87	....
er.	11.33	3.96	7.37	65.07±.66
Standard Deviation				2.19±.47
Coefficient of Variability				3.36±.72

*Head not included.

TABLE V SHOWING EDIBLE PERCENTAGE OF DRESSED WEIGHT IN TURKEYS

No.	Aver. Wt. per Bird in Lbs.			Per Cent Edible of Dressed Weight
	Dressed	Offal	Edible	
1	12.87	4.75	8.12	63.09
2	9.87	3.26	6.61	66.97
3	10.00	3.25	6.75	67.50
4	7.75	2.16	5.59	72.12
5	11.50	3.98	7.52	65.39
Total	51.99	17.40	34.59	....
Aver.	10.39	3.48	6.92	66.53±.56
Standard Deviation				1.85±.39
Coefficient of Variability				2.78±.59

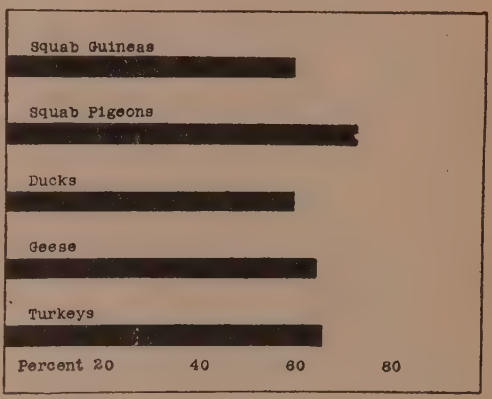


Fig. 1 - Showing Edible Percentages of Dressed Weight

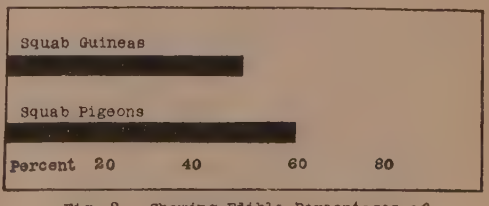


Fig. 2 - Showing Edible Percentages of Live Weight.

60.66±.37, and are illustrated in Figure 2. The difference with its probable error is 10.94±.49 and is therefore quite significant.

Concerning the other three kinds of birds, the surprising feature is that the edible percentages of the dressed weights in geese and turkeys are more nearly alike than in geese and ducks. Turkeys stand first with 66.53±.56, geese second with 65.07 ± .66, and ducks third with 60.17±1.10. This situation is illustrated in Figure 1.

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Recent Developments in the Breeding of Horticultural Plants.*

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The breeding of fruits, vegetables, and ornamental plants has become a very popular line of work at the Agricultural Experimental Stations both in Canada and the United States, and by private individuals as well.

The need for better varieties to take the place of the fruits and vegetables already on the market, and for more beautiful varieties among ornamental plants has become more and more impressed upon many workers.

Before the fruit and vegetable business became as specialized, as it is to-day, growers were from time to time content to take advantage of any variety that had been originated or been found by chance if it were an improvement over another one, but often a long time elapsed before a new sort would come to the front to take the place of an older one. To-day, however, when the shipping of fruits, vegetables, and flowers long distances has reached such large proportions, the weaknesses of existing varieties is continuously impressed on growers, shippers and consumers, and new and better sorts are constantly looked for, hence the systematic breeding of plants has taken an important place in the horticultural world.

It has been said that better things have been obtained by chance than have so far been originated by the plant breeder. This is true in the case of the apple, and to some extent with certain other fruits also. Nearly all of the best varieties of apples as gro to-day were originated as chance seedlin but think of the time it has taken to build the list we have! Baldwin originated ab 1740; R. Island Greening still earlier, pr ably about the beginning of the 18th c tury; Fameuse, no doubt, originated bef 1700; McIntosh Red originated in 179 King of Tompkins County originated bef 1800, the date being unknown; Northe Spy originated about 1800; The Duchess Oldenburgh apple is a very old Russian v iety; Wealthy and Delicious are two of most recently introduced, although seed fr which the former came was sown about 18 Nearly all of these were chance seedlin There has not yet been time to realize the sults of the work which has been done apple breeders as I estimate that it ta about forty years from the time of maki the cross until the new variety is on the m ket in quantities, and the systematic bre ing of apples has not been carried on many that long yet.

In the case of grapes, strawberries, c rants, gooseberries, and raspberries, wh a relatively short time is required to get sults, there has been a large number of f varieties originated by plant breeders t are among the leading sorts in commerce day.

*Paper given before Eastern and Western Ont branches of C.S.T.A., March-April, 1923.

Among flowers, many varieties of paeonies, irises, and roses, for instance, introduced in recent years, have been the result of systematic plant breeding.

If is is agreed that the horticultural plant breeder is able to do useful work for fruit, vegetable, and flower growers, it should be of interest to know something of his difficulties and some of the things which have been learned by recent investigations.

It was not known until recently why such poor results were often obtained in getting a set of fruit when certain varieties were used as parents in certain combinations. It was known that certain varieties were sterile to their own pollen, and it was recommended to plant some other variety blooming at the same time near such to ensure a good crop of fruit. On closer investigation, however, it has been found that some varieties act as if they belonged to different species and when crossed with one another will set little or no fruit. They are incompatible. Dorsey, from his studies with the pollination of plums, and, more recently, Beaumont of Minnesota, in his experiments with apples, shed further light on some of the causes preventing the setting of fruit when certain varieties are used as parents. If, after the pollen germinates, the pollen tube does not reach the ovary in time or does not reach the ovary at all, fertilization will, of course, not take place. Beaumont found a great difference in the length of pollen tubes of different varieties after a certain time. As examples, the pollen of Delicious apple produced an average tube length of 2.81 m.m. in 24 hours, while Winesap varied from 1.30 to 1.89 m.m. in the same time. There was 88.5 per cent. of Delicious pollen which germinated and only 36.9 per cent. of Stayman Winesap. It was found that pollen of different varieties had best or optimum temperatures for germinating. The stigmas of certain varieties stimulated the growth of pollen more than did those of other varieties, McIntosh being found to be one of the best stimulators. On the other hand, the stigma of Delicious is weak in stimulating growth, though its pollen germinates well and grows rapidly on other varieties. Stayman Winesap produces poor pollen tubes but its stigmas are good stimulators.

All of these things, and others also, have been found to effect the setting of fruit, and plant breeders now are endeavoring to find out which parents are best for certain purposes. Before long there will be a Dictionary of Correlations where the results of the experience of all plant breeders is brought together and where one, who is breeding for a certain purpose, will be able to find the varieties carrying the correlations which will give the combination of characters which he desires to obtain. This, naturally, brings one to Mendel's law, which is proving of great assistance to horticultural plant breeders, especially those working with annual plants or perennials, from which new generations can be obtained at short intervals and where it is possible to soon obtain homozygous strains. It is quite different with open pollinated fruits, which appear to be very complex in character, and which require from five to ten years for each generation, and from which it might take longer than a man's lifetime to isolate strains in the way one can do with plants which give a new generation in one or two years.

However, though it may take too long for many to take advantage of Mendel's law in the breeding of tree fruits, yet we believe, that great progress can be made by studying correlations when different varieties are crossed. Hence, at the Central Farm we are using many parents in the work, no less than 71 having been used in the case of apples, and these in many combinations. It is believed that greater progress can be made by obtaining a smaller number of individual trees from each of a great many combinations of parents than in having a few parents with a large population from each crossing. Once, however, it is found that a certain combination of parents results in the kind of fruit one is looking for, then larger numbers should be used. Thus, at the Central Farm, as at the New York Experiment Station, the Iowa Experiment Station, by C. P. Newman, Town of LaSalle, P.Q., and, doubtless, by others, the McIntosh has proved one of the best parents to use where certain McIntosh characteristics are desired in new varieties. Northern Spy also has been a good parent though, not being quite hardy enough, may not prove quite so valuable at Ottawa, but

some crosses with Northern Spy and hardier sorts are very promising.

There has been much discussion in recent years in regard to bud heredity in horticulture, and especially in fruits, but evidence is piling up, year by year, to prove that apparent differences in the yield of individual plants of the same variety are not permanent but are due to differences in the seedling stocks on which these trees are propagated; to differences in soil moisture; and to differences in the soil itself. A few of the most recent statements in regard to this may be mentioned.

In California, Shamel has found great differences in individual orange trees both in the character of the fruit itself and in yield. The differences in yield are explained in an experiment reported upon by Dr. H. J. Webber in a paper on "Stocks and Scions with Reference to Citrus" presented at a meeting of the American Society for Horticultural Science held at Boston, December, 1922.

Briefly stated, eighteen each of large, medium, and small stocks of the same age were selected. They were grown in a nursery for a year and then budded. After five seasons' growth, the average size of the top of the trees propagated on the large stock was 286.40 cubic feet, and of the small 147.67 in the case of the grape fruit, and in the case of the Navel orange 190.17 for the large and 89.65 cubic feet for the small. Those on intermediate stock came between. The trees on the large or strong stock bore first, and up to date the yield has been twice as great as from those on the small stock. A sixty-acre orchard of Valencia oranges was referred to where trees on twenty acres were on large stock and twenty on intermediate and twenty on small. There was fine, strong growth in the first twenty acres, fair growth in the next, and very variable and much inferior growth in the last. Returning to apples, most of the trees we buy are propagated on French stock grown from cider apple seed, which varies much in its growth. It is now believed that much of the difference in yield from individual trees is due to the difference in the stock. If the stock is dwarfish the tree will be dwarfish, and, while it may bear earlier than that on the stronger stock, it will not bear nearly as much over a long period.

In an experiment at the New York Experiment Station they obtained the Baldwin apple from forty-eight different sources in various parts of the United States. The fruit of Baldwin varies somewhat in different states due to climatic conditions, but when they were all brought to New York and grown under similar conditions there they all became normal Baldwins as they grow in New York State.

The Maine Experiment Station has published a bulletin by Karl Sax and J. W. Gowen (No. 151), 1922, "The Relation of Tree Type to Productivity in the Apple" and in their summary they state: "The primary causes of differences in productivity of fruit trees may be attributed to soil, root stocks, or scions. Soil was found to play an important part in causing differences of yield as indicated by the natural grouping together of the unproductive trees. Of the 257 unprofitable, unproductive trees, about 65% are apparently due to soil conditions, unproductive trees surrounded by only productive trees are unproductive due primarily to unfavourable root stocks, inherent differences in scions of the clonal variety, or factors other than soil. The percentage of such trees is about 35% of all unprofitable trees. There is no critical evidence that there are inherent differences in yields of apple trees of a clonal variety due to bud mutation."

In a report from the Royal Horticultural Trial Grounds at Wisley, Eng., A. L. Rawes states in the Journal, Vol. 47, page 163, after giving results of experiments on "The Comparative Cropping of Apple Trees Propagated from Parent Trees of Good History and Bad History. So long as the tree be healthy and free from disease, it matters little how it has behaved with regard to actual fruits borne, for such variation from the normal characteristics of the original tree of the variety are not transmissable and grow under suitable conditions and upon suitable stocks, the trees will reproduce the original vigor and cropping powers of the variety."

Much difference has been found in the yields of apple trees at the Central Farm of the same variety planted at the same time and these have been propagated to see if the

differences are perpetuated. The experiment has not gone long enough to warrant any definite statement but the results have been published. So far as evidence goes the Fameuse apple is the same today as it was 200 years ago, the McIntosh, as it was 100 years ago, and all the other varieties of fruits since the time they have originated. The same may be said of flowers such as roses, paeonies, irises, and others, varieties of which are propagated vegetatively, and not from seed. It is true there have been a few mutations so far as color of skin of the fruit, or color of petals of flowers is concerned, but apart from that the evidence is that other characters remain unchanged. The potato may be included in the above, as the evidence is that this also does not change permanently by selection.

Progress in Animal Breeding.*

BY WADE TOOLE,

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The world ever clamors for something new. It matters not in what sphere our lot is cast, the call for the production of new materials is always upon us and the man who does not progress loses the race. Perhaps many people still believe that there is room for new breeds of live stock and that Canadian breeders and investigators should be bending every effort to produce them. Perhaps new breeds could be produced to meet certain special conditions better than they are now met but the writer believes that greater progress for the good of the live stock industry would surely follow a policy of fewer breeds with better breeding. For concentrated effort, for uniformity in output, for competition in world markets, for most profit to the farmer and greatest satisfaction to the consumer we already have too many breeds in some classes of stock. True, there is room for all the breeds, but because we have wide acreage and somewhat diversified conditions is no reason why those acres should be grazed over by, and be growing feed for, anything but the most suitable breeds from the viewpoint of both producer and market man. The day of keeping a breed because our "likes" so dictate should be gone forever and the breed, whatever it is, should win its place only through its ability to produce, at a profit to the breeder, the highest grade product in demand by the consumer. In short, markets are exerting a greater influence than ever before in breeding work and there is no doubt that such influence must continue.

Keeping this in mind the progress that is being made in animal breeding is not so much toward the production of more breeds but rather toward early maturity and improved type in the breeds already in existence. If we had fewer breeds we could make more rapid progress. Indications are that certain breeds must gain the ascendancy and these will be those which are bred to supply what the consumers want and at the same time pay the feeder highest returns for his effort. New breeds may come, as did the Corriedale sheep in New Zealand, to fill a special want, but better individuals and stronger strains in the best breeds we have is the goal of the present day breeder in Canada. New Zealand wanted a sheep that flocked easily. They wanted a bigger sheep than the Merino with a better grade of wool than the Lincoln so they made a dual-purpose breed by crossing Lincoln rams on Merino ewes and practising careful selection. The production of Persian lamb in Canada is another case where certain methods are followed to produce a special article. The writer has heard that a certain well-known Professor in one of the leading United States Colleges is at present busy in the making of a tail-less breed of sheep to get around the trouble of docking and by selection, it is said, progress is being made.

*Paper given before Western Ontario Branch of C.S.T.A., April 27, 1923.

SHEEP

So far as sheep are concerned breeding work is pretty largely confined to selection in our recognized breeds with the idea of meeting the market. Now, that market demands the finer and medium grades of wool and the eighty-four pound lamb and it would appear that so far as markets for mutton sheep are concerned the Down breeds may get the inside track. Fifty-six per cent. of a lamb carcass is leg and back. Thirty-six per cent is fronts, and 7 per cent is flank. We are after the biggest possible percentage of leg and back which sells for just twice a smuch per pound as front quarter and eight times as much as flank. Progress is only made by keeping weight and type in mind.

So far as fleece is concerned the finer the quality the better.

Experimental work in flushing ewes has proved very profitable in increasing prolificacy.

From a study of 500 yearlings in each breed mentioned, the following conclusions are warranted:

'1. The relative standing of the breeds of mutton sheep in Canada with regard to prolificacy is, Dorset Horn 161.6% increase, Leicester 154%, Oxford 152.2%, Hampshire 149%, Suffolk 148.2%, Lincoln 144.8%, Shropshire 143.6%, Southdown 142.2%, Cheviot 139.8%, Cotswold 138.0%, Romney Marsh 113.9%.

2. The average increase for all breeds of mutton sheep in Canada is 144.6%.

3. The average increase for all long wool breeds of mutton sheep in Canada is 138.5%.

4. The average increase for all Medium Wool breeds of mutton sheep in Canada is 148%.

HOGS

In hogs a few comparatively new breeds have sprung into prominence in Britain but in Canada and the United States opinion seems to be that we could do with fewer breeds. In Canada, hog grading and the general campaign to secure and hold the Old Country market is forcing more consideration of the bacon hog and already breeders of lard hogs are asking for boars of the bacon breeds. Perhaps we have too many so-called bacon breeds. In Denmark all hogs are of similar breeding. True, they have Yorkshires and Landrace breeds but the father of the Landrace breed was a Yorkshire boar. So the product of the pens of Denmark is uniform. Canada has seven or eight breeds and all their combinations. Under such conditions uniformity is not easily obtained. And yet experimental work seems to show that there is more in strain than in breed. Only recently, four out of five pigs from a pen of Duroc Jerseys (a lard breed) graded leanest select bacon. The question bothering the thinking producer is, however—Is life not too short to attempt to undo years of building in one direction to construct in another direction where we have the right type established in other breeds? Usually making over old buildings costs more than building new and results in a patched-up job. Progress is being made with the bacon hog in Canada and experience has taught some breeders that we have a better type in our highest type in some breeds than can be bought in the home of those breeds. The trouble is we haven't enough good ones and we have too much crossing and indiscriminate breeding.

Hog breeding in the United States has been passing through a transition period. Corn and the lard hog go together but the lard hog over there got so lardy that he had little bone, growthiness and size left. Moreover vegetable oils cut in on the animal fat market and down went the price of lard. All the while, the public were asking for more lean meat. So the American breeder, with a bang, picked out the largest, longest-legged, heaviest boned, most slab-sided pigs he could find in his litters and attempted to get a new type. He made progress a little too fast. However, common sense will prevail and out of it all is coming a sensible, "big-type" lard hog with length for bacon and a much higher percentage of lean to fat and more bone to carry his greater size, and, they have the nerve to call him "the lard hog with the bacon tendency."

Sixty per cent of a bacon hog is Wiltshire side.

Eighty per cent of a bacon hog carcass is Wiltshire side.

In a hog finishing test at the O.A.C. starting with pigs weighing 136 lbs. each the following results were obtained:

Breed.	Lbs. Grain Per Cwt. Gain	Grading	Dressing %	Profit
		All	77.4	
Poland China	476	thick	75.4	5 cts.
		smooth	79.8	
		All	73.7	
Duroc Jersey	387.4	thick	71.5	4.79 cts.
		smooth	76.4	
		1 thick smooth	78.1	
Yorkshire	417	1 prime	79.1	6.67 cts.
		1 leanest	74.4	
		1 thick smooth	73.2	
Berkshire	397.8	2 leanest	76.7	5.52 cts.
			75.5	
			75.7	
Tamworth	406.3	1 unfinished	76.9	3.56 cts.
		2 leanest	74.5	

From a study of 5600 litters in Canada nd a large number of litters in Illinois the ollowing results were shown regarding breed rolificacy:

PIGS PER LITTER

	Illinois	Canada
orkshire	11.6	10.2
hester White	9.6	9.3
amworth	9.4	9.4
uroc	8.7	8.4
erkshire	7.4	8.3
ampshire	—	8.2
oland	6.6	8.0

CATTLE

In cattle breeding some of the most interesting breeding work from a strictly scientific viewpoint, of course, is the hybrid cross f the bison on domestic cattle. It seems asier to get hybrids by crossing a bison bull n domestic cows. Females predominate and re fertile. Males are infertile. The Zebuow cross has also produced interesting relts but the percentage sterility and reproduction troubles experienced in these hyrids practically eliminates them from use y the average breeder. At present, breeding rogress in beef cattle is toward early maurity, high percentage of lean meat to fat nd high development where the best cuts re placed on the carcass together with economy of gains. Today the market wants a highly finished, light steer.

The loin and the ribs are approximately 50% of the value of the carcass.

The loin and the ribs and the round constitute the "best" cuts.

Value of Breeding in Beef Production

Table showing Profit or Loss over Original Cost, Feed and Marketing, in an experiment to show value of pure-bred bull in beef production:

Group	Loss	Gain
Cross-bred	—	21.80
Grade	—	14.70
Scrub	22.73	—
Dairy	69.11	—

In dairy cattle we are after cheap production of milk and fat but must not forget type and constitution. In fact, in all animal breeding constitutional vigor is bound to be of increasing importance.

How much disease do we breed into our farm animals?

How much do we feed into them?

The Effect of Age of Sire and Dam on Quality of Offspring in Dairy Cows.

The percentage of superior or high producing dairy cows is no older than the percentage of comparatively inferior or low

producing and thus the old animal is no more valuable as a parent than the young one.

As far as the age of either parent is concerned, the young born at one time in life seem to be just as valuable as the young born at any other time.

A very large percentage of our cows are born of immature parents but the proven animal at any age is much more valuable for breeding purposes.

On the average, cows make their best records at about six years of age.

HORSES.

In horses, our big problem, as in all other breeding, is sires. There are only a few real sires and they seem fewer in horses than in other classes of live stock. Horse breeding has made poor progress in Canada in the last few years. The same is true of the United States. Without outstanding sires we can get nowhere and in the heavy breeds, in Canada, we have few of this outstanding kind. We have breeds for all purposes, and perhaps too many. Commendable efforts have been made by the light horse breeders in Canada to produce high class saddle and h ter horses by bringing in some good thorou bred stallions from the Old Land. Ho breeding work awaits a revival wh seems certain. All that the breeder needs more rigid selection of breeding stock.

The breeder has problems. When he g his herd as good as the best, then what? must line-breed or in-breed. This is wh mistakes are made and yet our best breed are doing it. Nothing but the best is go enough for these systems. The problem What will be the ultimate effect upon prolificacy of our stock? No one kno Breeding for prolificacy and health must kept in mind.

Progress is being made but we must forget that the war set us back several yea Abnormally high prices made everythi marketable. Careless mating resulted and retrogressed. Market competition is bri ing us to our senses and we are getting on right road. So far as live stock breeding concerned an interesting problem prese itself viz: The co-relation between parts a their relation to production.

Book Reviews.

"A Bacteriology Text-Book." For students of Agriculture, Medicine and the Industries. By the late H. W. Conn, Ph.D., formerly Professor of Biology, Wesleyan University, and Bacteriologist of the State Board of Health of Connecticut, and Harold J. Conn, Ph.D., Soil Bacteriologist at the New York Agricultural Experiment Station. Octavo of 431 pages, with 48 figures. Baltimore: Williams and Wilkins Co., 1923.

In Part I the authors open with an excellent historical introduction, tracing the evolution of bacteriology through four stages:— The period of speculation, the period of fundamental discoveries, the development of methods, and the era of development 1881 till to-day. The remainder of Part I on Micro-organisms and their activities include a description of organisms, classification and physiology.

Part II (pages 113-244) on Non-Pathogenic Organisms deals briefly with micro-organisms in the dairy industry, of the soil in relation to food, and miscellaneous industries.

Part III (pages 247-409) is devoted to Pathogenic Organisms, both human and animal. Chapters on the cause of disease, res tance and immunity, sanitation and parasi diseases have been alloted considerable spa The bacteriology of water and sewage treated sufficiently at length for a text of t character. Chapters XII, XIII and XIV Bacteria in Relation to Plant Diseases are troduced with a view of correlating for t student plant and animal diseases.

In part IV appendix pages 413—425) to be found the most recent methods of me preparation, characterization of bacteria, a re-action of media and hydrogen-ion conc tration.

The authors in their preface say that book is intended primarily for college cl ses in first year bacteriology, composed pa ly of students who intend further speciali tion and partly for those who plan to t no further work, but wish a general kn ledge of the important applications of b teriology. Instructors will find the bo readily adaptable to agricultural bact iology. The book is highly commended college students.

F. C. H

Animal Pathology in Relation to Agriculture and Public Health.*

E. A. WATSON,

Health of Animals Branch, Department of Agriculture, Ottawa.

One of the legacies of the war of 1914-18, s the world-wide impetus given to scientific esearch and teaching. The value and im-ortance of science was so fully revealed in he great war that in place of former apathy nd neglect the mind of all peoples has been roused to daring thoughts and new concep-ions. The best answer perhaps to the ques-ion 'who won the war?' is that Science won t. May we not hope that Science will also vin the peace; that co-ordinated scientific ffort and achievement will succeed where, t should be fairly evident by this time, poli-ical intrigues have failed and must fail. f the 'League of Nations' could be trans-ormed into the 'League of Science' a full nembership could soon be obtained and very nuch accomplished.

It is to science that we now turn hopefully nd expectantly for the solution of the main roblems which in agriculture, in the indus-ries, in health and disease, bear upon a na-ion's welfare and prosperity.

Everyone recognizes that the furture of Canada lies largely in the development of Agriculture. The basic industry of Agricul-ture itself is the animal industry which, furthermore, is a key-industry and if appraised in money value alone, is the greatest industry on this continent. It is unnecessary to dwell upon these facts before an audience such as this; it is sufficient to keep them in mind and to emphasize the point, if needs be, when striving to better the conditions for the study of the many problems awaiting solution. As progress is made in agricultural development, new and more complex problems constantly arise, and it becomes necessary, from time to time, to readjust our institutions and facilities, ourselves and our points of view, to recognize and to establish the relationship between one science and another and to extend and co-ordinate our work and responsibilities. The Veterinary scientist or animal pathologist has to regard these readjustments from two angles of view, that of the animal industries on the one side and that of public health on the other side.

It has been said, and is still sometimes so expressed, that the veterinarian has nothing to do with public health and should concern himself wholly with live stock and the animal industries. A moment's reflection should suffice to show that such a claim is untenable, for the problems of health and disease in man and in animals all really belong to the same category. In teaching and in practice the medical and the veterinary sciences have developed concurrently, inter-communicating and interlocking at every important stage and epoch and with interminable points of contact from beginning to end. It cannot be otherwise. The fundamental principles underlying disease, disease-control and prevention are the same in animals as in man; it is only in methods of their application that differences or modifications arise. The physician has to take into consideration human happiness, comfort and social order; whereas the veterinarian, in dealing with animals has to concern himself with the economic factors.

It may profit to call to mind a few of the outstanding discoveries and achievements which have so greatly influenced and advanced the progress of medical and veterinary science, jointly.

Edward Jenner interested himself in a study of variola, cow-pox and horse-pox. In 1796 he inoculated a child with cow pox, tested the effect by inoculation with small pox and found that immunity had been achieved. His great conception of the prevention of small pox by vaccination was thus justified and in practical application it has averted an immeasurable amount of human suffering and misery. The possibilities of vaccination and immunization, fathered by Jenner, the great clinician, caught the imag-

*Paper given before Eastern Ontario branch of C.S.T.A., March, 1923.

ination of Pasteur, the laboratory worker, who, with incomparable skill, accurate technique, and thoroughly scientific methods, demonstrated prophylactic vaccination against anthrax, chicken cholera, swine erysipelas and rabies or hydrophobia. These tremendous achievements represent only a part of Pasteur's great work on which is founded the science of bacteriology and immunity, and which cleared the way for the discoveries of toxins and antitoxins and for the successful application of vaccine and serum therapy in diseases of man and animals.

Discoveries in connection with tuberculosis, blood parasites, insect carriers and transmitters of disease, have resulted from medical and veterinary research jointly, and in the field of comparative pathology.

Apart from diseases which are common to man and to animals, or diseases communicable from the one to the other, there are many pathological conditions, bacterial infections and parasitic invasions which, though etiologically different in man and in animals, parallel one another in their course and manifestations. Assuredly, a discovery or advanced knowledge on the one side will find its application on the other.

It is unnecessary to go further into the comparative aspects of disease to show the relationship between human and animal pathology as it has existed in the past, and to indicate the closer association desirable in the future. Plant pathology should also be remembered in this connection, for although plants and animals differ fundamentally in structure and in physiological processes, plant diseases offer many problems that are of importance as sources of information concerning comparative pathology as a whole. We know that plants, in common with animals and man, are subject to diseases caued by ultravisible viruses, bacteria, fungi and parasites. The plant pathologist and animal pathologist can co-operate in the study of botulism, ergotism, and various forms of forage poisoning.

In the animal industries the source of the greatest economic loss and the greatest impediment to progress and development is the direct result of disease. Other detrimental factors, such as poor or improper feeding, poor judgment in selection and breeding, poor care and management in general, result ing in inferior quality and low production can be overcome by correcting obviou faults. Artificial barriers, such as tariff walls, embargoes and closed markets ca be made and unmade at will. Disease, o the other hand, results in direct and irrepar able loss and, if unchecked, brings ruin an devastation in its train. Veterinary scienc furnishes the structural lines for the attac on animal disease and of methods of contro suppression and prevention. Were it not fo the protection afforded by the systematic ap plication of modern veterinary scientifi principles and methods of disease prevention by competent and fully qualified veterinar ians, the livestock industries would be face with calamity instead of with the prospec of further safe development and prosperity A set-back almost immediately follows a re laxation of veterinary activities. Thi is brought forcibly to mind by the recent bit ter experiences in the Central States of Eur ope and in the very countries where, prio to the war, veterinary control was at its high est stage of efficiency. Towards the close o the war, and subsequently, through the dis organization of veterinary services an through indifference or inability to appl the control measures needed, infectious dis eases were allowed to spread all over con tinental Europe. The three most dreaded an mal plagues, foot and mouth disease, contag ious pleuro-pneumonia and rinderpest sprea with alarming rapidity and disastrous results Hog-cholera, mange, dourine and rabie more or less followed suit, while a numbe of other slumbering diseases were awakene into unusual energy and activity. Glander on the other hand, that loathsome and fata disease of horses and communicable to ma was almost totally suppressed, thanks to th army veterinarians who were fully alive t the danger and, by the universal applicatio of the mallein diagnostic test, stamped ou glanders infection as soon as it made an ap pearance. Russia is the exception, for i that country the disease became rife after th revolution and, so it has been reported, ha claimed hundreds of human victims wh contracted the disease by the handling an eating of glandered horses. In short, all th dissemination of infectious material throug out continental Europe has brought inestim

able harm and loss to the live stock industries; and the resulting insufficiency in the supply of milk, meat, and animal food products has caused a lowering of the standard of living in those countries and a decline in public health.

Turning now to Canada for a brief review of the situation as regards the health of animals, we may indeed feel fortunate in having escaped many of the dreaded diseases to which animal flesh is heir. Those which we have not escaped have, for the most part, been vigorously dealt with and marked progress has been made towards their suppression. Without going into wearying statistics, the significance of a few figures showing reduced losses may be noted. Dividing the last ten years, for which statistics are available, into two five-year periods, 1912-1916, and 1917-1921, inclusive, the loss in animals from *glanders* was reduced from 2423 to 616, the loss from *Hog-cholera* from 53,094 to 13,994, and the loss from *dourine* from 1129 to 71. The total loss from these three diseases in animals destroyed was reduced in five years by 51,965 (66,646 to 14,681) and the cost in compensation reduced by $523,846 ($701,478 to $177,632). Dourine has been totally suppressed, not a single case having been discovered for two years past. The campaign against another disease, mange in cattle, which became so widespread in Western Canada, has also triumphed. Anthrax and rabies are kept down to a minimum by prompt action, while black-leg is prevented by prophylactic vaccination.

An arduous and costly campaign aiming towards the eradication of bovine tuberculosis has been successfully launched. The accredited herd plan came into operation just over three years ago and has entailed up to this time, 145,840 tuberculin tests and the disposal of 11,915 tuberculous reacting animals, at a cost in compensation paid to the owners of $1,281,459. There are now in Canada 412 fully accredited herds and 1043 herds under process of accreditation. The municipal tuberculosis order is being taken advantage of by a number of municipalities; and there is an increasing demand for the testing of dairy herds as the dangers from tuberculous milk become better realized.

Infectious abortion, with sterility as a common sequel to it, is one of the greatest problems to be solved. More actual loss, probably, is caused by this condition than by any other disease or group of diseases affecting live stock. It is said, in fact, that the total loss from all other causes and factors does not approach the loss from infectious abortion. It is one of the most difficult and complex problems to study. Owing to the widespread and practically universal distribution of this infection, quarantine restrictions seem to be impracticable. The establishment of an experimental station solely for the purpose of an exhaustive study of abortion, in all its phases, would seem to be the most logical, practical and necessary thing to do.

Haemorrhagic septicaemia, botulism and various forms of forage poisoning exact their annual toll from owners of live stock. And then there are the parasites, the lung worm and the stomach worm, and the parasites of the liver and of the intestines, associated very frequently with the so-called deficiency diseases, and lack of minerals and vitamins which are essential for proper nutrition and animal growth.

Nevertheless, it may safely be said, I believe, that Canada compares very favourably with any other country having animal industries comparable in growth and extent. But even so, we have our problems and big problems too; and the animal loss from disease, in spite of all that has been accomplished in suppression and prevention is still an enormous one. During the past 11 months $877,063 have been paid out in compensation for animals destroyed under the animals Contagious Diseases Act, including tuberculosis; and this is only a small fraction of the money value of the actual losses from all diseases.

In the United States, where conditions in many respects resemble our own, the losses from disease, as estimated by the Chief of the Bureau of Animal Industry, exceed 200 millions of dollars annually. In Great Britain and in South Africa millions of pounds sterling are lost in the wastage of animals from disease. Under the conditions of more intensive agricultural development and with an animal population of growing density infectious and parasitic diseases have more favourable opportunity for appearance and spread. With the animal husbandman cull-

ing, selecting and breeding with the main object of increased production, a lowered resistance and an increased susceptibility to disease is the likely outcome. To meet conditions that are constantly changing, readjustments of the work in animal pathology and research must be a continuous process, and there is nothing so likely to have fatal consequences as the unpreparedness that comes from over-confidence and a past reputation.

The popular view, held for so long, that veterinary science meant simply the doctoring of sick animals has almost faded away and owners of live stock are beginning to learn that it is more profitable, in the long run, to prevent the appearance and spread of a disease than it is to cure it. The consumer is showing a preference for approved or certified meat and animal food products and the danger to human health and welfare through damaged food products and from communicable animal diseases is being recognized. It is evident that the scope of animal pathology is widening, day by day, and instead of narrowing its boundaries as some would have it, the field should extend in every direction where disease is manifested or where it may be anticipated. It is far too big a field for any one individual to cover, and specialization in the different lines of co-related work is inevitable and most necessary. The great difficulty at present in Canada is to find and secure the specialists needed for veterinary research. The remuneration offered does not attract them, and the modern laboratory facilities needed for their work do not exist. In all Canada, with its great and growing animal industries, there is not a single institution where men can properly train for research work in animal pathology. The veterinary colleges are graduating men ready and eager to enter a career of veterinary research. But to obtain the necessary training and facilities they must go outside of Canada, and having done so there is little or no inducement for them to return.

This is indeed a serious matter and should receive the careful consideration of all those interested in the needs and development of the animal industries. There is a gap that must be filled, not by pseudo-scientists and quasi-scientific adventurers, but by men with the necessary qualifications and experience by competent veterinarians with all the resources of comparative pathology at their command.

The work suffers and progress is delayed through inability to secure the qualified research workers needed and through inability from lack of modern institutions and facilities, to give men the proper training and opportunities. We lack even the technicians for carrying on the necessary laboratory routine work.

It is sometimes said in reply to this, that great discoveries have been made in most humble surroundings and with very meagre resources. True enough, some highly important work has been done even in log cabins and in flimsy shacks set up on the prairies, and may yet be done. But the field for pioneer research appears to have been fairly well covered and to be narrowing down to the study of local conditions and to the collection of specimens and material for laboratory investigation. A more and more exacting and precise technique is required for the study of the complex problems as they are now presented and this is possible only in modernly constructed and equipped laboratories. Without the requisites necessary animal pathology cannot properly function in relation to agriculture, and the animal industries will continue to suffer annual loss from preventible disease.

It occasionally seems as necessary and profitable to point to the causes, conditions and handicaps which underlie apparent failure and little accomplishments as it is to dwell upon achievements and success.

The relative importance of different lines of work and endeavour in agricultural research, including animal pathology, is often disregarded or distorted. The newest problem and the latest claim or discovery, if it is a discovery, attracts quickest attention and overshadows, for a time at least, the older more important and still unsolved problems. The main objective is easily lost sight of in the distraction of minor considerations, especially as the tendency is to investigate such conditions as give promise of a quick return, to follow a line of least resistance as it were, and to leave the real and most difficult problems to a few determined work-

ers. More regrettable still is the growing tendency for problems in animal pathology to be dealt with by men without veterinary training or experience. There is a legion of amateurs running at large advising on subjects of which they have but a most superficial knowledge or, armed with a hypodermic syringe and readily supplied with a stock of drugs, vaccines, bacterins and serums, by obliging commercial firms, inject these promiscuously into animals which suffer the consequences.

Such unfortunate tendencies have arisen, perhaps from the popular cry for "results", for immediate results, for "practical" men and not for scientists. The bane of empiricism holds back the application of scientific knowledge and method and is a serious hindrance and danger to progress.

The big problems in animal pathology can only be solved by an active spirit of study and discovery and by intelligent discussion and criticism.

We should not be discouraged by those narrow minds who disdain everything in science which has not an immediate application. To the skeptical question "what is the use of it?" so frequently heard at the demonstration of a purely scientific discovery, we may give Franklin's simple answer—"what is the use of a new-born child?"

I have told you nothing new in these random thoughts, hurriedly put together. The subject, considered by itself may be important, and in the great biologic scheme of things relatively insignificant. Individual efforts like theoretical discoveries have but the merit of their existence. But as Pasteur said, they give rise to hope; let them grow, let them be cultivated and see what they will become.

New Officers for C. S. T. A.

The results of the annual elections for the named officers of the Canadian Society of Technical Agriculturists for 1923-24 are as follow:—

President—H. Barton, Macdonald College, P.Q.

Vice Presidents—E. A. Howes, University of Alberta, Edmonton; Jules Simard, Dominion Seed Branch, Quebec.

Honorary Secretary—L. H. Newman, Dominion Cerealist, Ottawa.

The election ballots were opened at Ottawa on May 1st, and the above results were announced through the Associated Press on that date. Approximately four hundred members voted.

CONVENTION DELEGATES

With the exception of the Prince Edward Island local all branches of the Society have appointed delegates to attend the Saskatoon convention. Their names follow:—

Alberta—C. E. Bain, E. A. Howes, E. Ward Jones.

British Columbia—V. S. Asmundsen, G. G. Moe, R. L. Ramsay.

Manitoba—C. H. Lee, A. C. McCulloch.

New Brunswick—J. H. King.

Nova Scotia—M. N. Tompkins.

Eastern Ontario—E. S. Archibald, G. H. Clark, G. P. McRostie, L. H. Newman, P. Stewart.

Western Ontario—B. L. Emslie, A. Leitch, E. F. Palmer, J. B. Reynolds, W. J. Squirrel.

Montreal—Rev. Father Leopold, J. E. Montreuil, Gus Toupin.

Macdonald—T. G. Bunting, A. R. Ness, J. F. Snell.

Quebec—A. Désilets, F. N. Savoie, J. A. Ste. Marie.

North Saskatchewan—W. P. Thompson.

South Saskatchewan—R. W. Neely, W. W. Thomson.

These delegates have been appointed in accordance with the by-laws of the Society, each branch appointing one delegate to every twenty members or majority fraction thereof.

Education and Agriculture.

A Brief for the Agricultural College Graduate.

BY H. E. HALLWRIGHT,

Victoria, B.C.

In his presidential address at the Annual Convention of the C.S.T.A. in June, 1922, Dr. L. S. Klinck reminded the meeting that, of the three main functions with which the Society is primarily concerned, Agricultural Education is foremost in importance. In concluding his address he was emphatic in the suggestion that Canadian Agriculture "sorely needs the inspiration of a spiritual ideal —needs to be shot through and through with spiritual purpose."

It is more than gratifying to one who has given just about equal time and consideration to general education and agriculture, to receive this "statement of faith" from so widely experienced a man as Dr. Klinck, as, from observations made in England, the Prairie Provinces and British Columbia on the relationship which exists between agriculture and any phase of education, the conclusion is that public education, at all events, can never be a success until Agriculture and its complement, "Home Economics", are adopted from the start as the groundwork and co-ordinating factor of our educational policies, for the very reason that these fundamental interests lie at the basis of home-life and character formation, and they alone can sustain that honest purpose and pure motive that distinguishes the true student of life from the blasé pedant or the obsequious toady.

In order to interpret this statement correctly it must be remembered that these subjects deal with much that is inherent in the average individual. In fact the very qualities that Agriculture and Home Economics engender are often developed to a high degree in exceptional types through their home environment, manifesting as that loyalty and altruism which set them off in a class by themselves. These qualities are often unknown to the one who possesses them, but are instinctively sensed and appreciated by his or her associates who naturally elevate such an individual to the privileges of leadership. These attributes, however, must be sustained and developed as the student advances in intellectual and other accomplishments, or he will become morally and spiritually deficient and lose his original capacity. This, as this article aims to point out, is normally effected through the fundamentals —Agriculture and Home Economics.

This conviction has more than a theoretical basis. Relics of such a system, where under the stress of a national crisis, supplemented by the labours of a true-visioned reformer, Bishop Grundtwig, agriculture and (to use a much abused term) religion were normally correlated, may still be seen in the co-operative capacity and agricultural finish of the Danish people. That the spiritual impulse was insufficient to sustain the original momentum manifest at this time does not in any way detract from the principle that agriculture and spiritual purpose are inseparably combined, and as far as man's life on this planet is concerned it is impossible to practice the one without the other for any considerable period.

There is a double danger of being misunderstood here which it would be well to avoid at the start. In the first place the logical conclusion from such a statement is that agriculture cannot exist without a spiritual motive. This is, as interpreted by the writer, exactly the point discerned by Dr. Klinck—that the danger that we, as agriculturists, are faced with today is that of becoming, not over-scientific, not excessively orderly, but over-technical, over-anxious to discriminate in fine points that have little or no practical value—we strain at a gnat and swallow a camel. Thus we miss the spirit of the subject by concentrating too closely on the letter. We are so absorbed in the form of our apparatus that we forget that it is only a means to an end, and so we lose sight of its function. Secondly, it may be asked, may not body but an agriculturist qualify for a hal

completing the course of experience which is world has to offer? This will depend how we interpret the term "agriculturist." may be suggested, however, in the light classic education alone that anybody who s not enough of that sympathy with nature comprehend the identity and function of e universe in Nature's symbols, who is able to discern the unity of life, has very tle scope for spiritual expansion. Such individual at best is bound to a narrow, tificial code of morals through which he nctions, honestly enough perhaps, but a ve to time and circumstance. No! We as ined agriculturists are not immune to this ltifying tendency, hence the words of Dr. inck.

Agricultural Education has a very differ- t meaning to the public school instructor agriculture than is conveyed to the purely hnical agriculturist, a meaning which as t is very little appreciated, or even under- od. It is really the normal development Nature Study by which Nature's laws e familiarised by their application to the actical benefit and profit of mankind rough direct instruction. As Mr. J. W. bson, Director of Elementary Agricultural ucation in B.C., has stated in an article pearing in a recent issue of the Agricul- al Gazette, this is "education through agri- ture" rather than "education in agricul- e". In this relationship agriculture is re- ded as a means to an end rather than an end itself since the student may never earn a nt directly through the technical know- dge he has gained in this manner, though does acquire incalculable assets in the oadening, character-building influence of subject.

Education has been defined as a science a branch of philosophy. In a sense this empt to locate education in our catalogue intellectual accomplishments is justifiable college calendar purposes, but in its ful- t sense, education is as undefinable as Dr. nstein's universe. In the last analysis it nscends intellect and rather seeks to cor- ate those intangible forces of personality th the rational nature, liberating the in- viduality, or in other words forming the aracter of the person involved. A broad ncept of Agriculture involves the same characteristics. The merely literary interpretation of the term is "the cultivation or development of the field" and what is the word "field" but an open space where Nature is at work? From this simple derivation alone, agriculture would include a study of the whole range of natural phenomena, and from technical agriculturists, acquainted as they are with the unlimited number of subjects which their study involves, there should be no serious objection to this postulate.

The point that must be borne in mind, however, is that not even science begins to comprehend the finer aspects of agriculture in all its phases. No matter upon what particular branch the student bestows his attention, not only must he bring to bear the whole gamut of specialised sciences upon the matter, but, as the complexity increases, more assumptions and postulates are involved, a more elaborate equipment is required for investigation and research, until the final struggle reveals nothing but conjecture and theories requiring still more delicate apparatus and still more complex generalizations for their proof.

The retort may be made at this point that this is true of all study. The writer is not unacquainted with the story of the professor who had devoted his whole life to a study of the definite and indefinite articles, "a", "an" and "the". On his deathbed he confessed that from the start he had made a radical mistake. He had attempted to cover too much ground. He should have confined his studies to the definite article alone. Yet agriculture has one great, outstanding advantage in this regard. As agriculture—not as some purely abstract science masquerading under the name, but as agriculture with its proper balance retained, with its inner and outer phases duly correlated—it never fails to return some practical workable principle, which can play its part in the economy of mankind, however small or simple the unit chosen for the research may seem.

This is because a unity of correlated factors is obtained which is necessary for practicality in any principle while the bare abstractions of specialized science are apt to draw from the practical observer the remark "quo bono".

In the study of agriculture the research worker starts out with practical intentions, and so is rewarded with practical results, provided that, as suggested before, he does not become obsessed by the wonder of his apparatus, so that he mistakes the "means to an end" for "the end itself."

The word "practicality" here is used in its broad sense. It must not be restricted to that which may be utilised for direct material gain, nor even, as the moralist would interpret it, that which may be converted into higher principles and more exacting conduct. It includes these values and much more. In short it means that which is directly profitable to the one who uses it and more often than not it may be applied to a larger understanding and keener perception of the values of life—that faculty otherwise known as "wisdom."

This outer factor of practicality assumes, therefore, a corresponding inner attribute—the quality of satisfying the reason, even when quite immature, of its irrefutable logic. Both the inner and the outer values exist in agriculture, because it is founded on Nature's code, uncontaminated by man's presumptious reasoning, and so it reflects absolute truth. The proof of the pudding is in the eating, and the student, however unsophisticated, must respond accurately to the consistent proof, which the symbols of agriculture continually provide. It is, therefore, adapted to the simplest mentality, although able to provide inexhaustible entertainment for the most complex. Thus education and agriculture complement each other in the incalculable need of the one and the inexhaustible supply of the other.

Though somewhat of an abstraction itself the argument just set out is none the less valuable to the scientific worker who would reconcile all phases of a question with fact, though to those who have little or no experience in teaching agriculture to juniors, it may seem extravagant. There is another aspect of the question, however, which is more easily comprehended than such technical phases of educational science.

It is becoming more evident every day that the primary cause of dissatisfaction in modern educational methods is the failure of schools to get in contact with the homes where the children are raised. In a revi of the educational paradox appearing in March, 1922, issue of the "Journal of Her ity", called "The Home and the School" O. F. Cook, Bureau of Plant Industry, U. Department of Agriculture, the author quo from an article in "The Villager", Ap 1922, entitled "One Father is Worth a H dred Schoolmasters". He then proceeds show the biological impossibility of train the growing mind against the double han cap of an environment which is natura suited to the peculiarities of the child's position, and in which the greater part his life is spent.

Various attempts to meet this inconsiste have been launched, all working in the ri direction but altogether inadequate to m the situation because of internal defects. is in this regard perhaps more than in other that agriculture holds the trump c in modern educational methods. It bri the teacher into the home and effects double purpose of imparting to him a bro er sympathy with the parents and of rec ciling them to ways and means of train children that are sometimes dubbed "fri and regarded as "an unwarranted expe in times of financial stringency". The ho project method of teaching agriculture becoming the approved form of element agricultural education, and it is to this m than through any other force that the w is becoming recognised and its claims cepted.

What does this method involve howev The primary requisite of an instructor public school agriculture is the mission spirit and sympathy with rural life tha more often than not lost in the imma desire to acquire technical finesse. Humi is the password to any permanent success the ambition to shine as an authority on t nical grounds has been the downfall of m than one earnest student of life. It is without certain misgivings that the wr proffers the above suggestion, lest it be ta as a protest against the action of the C.S. in providing scholarships for graduates agriculture who earnestly desire to specia No finer work could have been initiated t this all-important movement aims promote. Agriculture has yet to l her authorities to which the world

n on questions of scientific fact
h unquestioning confidence. But she
eds her army of labourers even more.
ly a special type of individual can hope
develop into a research worker, a mind
t will follow up a question, however dry,
the mere satisfaction of revealing the
entific facts behind. By virtue of this
ling passion, practical issues involved are
re often than not of secondary impor-
ce even in agricultural research, and gen-
lly receive attention from the bare neces-
y of keeping the wolf from the door.
is is a comparatively rare gift and it is
be hoped that ways and means will be
veloped not only to discover genius of
s type, but also to deter those whose work
s in other directions from taking such a
urse in order to perfect their technical
derstanding which at best can never be
re than a means to an end.

H. G. Wells' oft quoted statement that the
rld is witnessing a race between education
d catastrophe is true. Education lacks life
d purpose without agriculture. An army
agricultural graduates is needed to take
e work in hand and complete it. The move-
ent has only just begun and those engaged
it are having uphill work, but it is gain-
g impetus daily and those young men and
omen whose ardor and enthusiasm have
t been damped by the world's cloying
lm are needed to save humanity. They
one can do it for they alone have the vital-
and endurance to meet the test. The bat-
cannot be won without a struggle and
inforcements and moral support are need-
from all those who are able to be in-
ested in this momentous question. The
ain impulse must come from within the
nks of agriculturists before the movement
n progress in a manner which is adequate
meet the needs of our day. More direct
d intelligent sympathy from the C.S.T.A.
uld add a much needed stimulus to the
rk and would serve the double purpose of
engthening the movement and providing
opportunity for the highest service possible by agricultural college graduates, and those agencies for true education which originated and found sustenance in the unnatural foster-parent—War, may find their true parenthood in a peace-loving organization. School gardening and like movements were started to meet the extraordinary conditions brought about by the war, but the expansion and perfection of these basal factors of education must be reached through the support and control of a world-wide faculty of Agriculture. More attention should be given to perfecting the courses which are offered by our Agricultural Colleges with this end in view. The most vital step officially taken by any institution in this respect was made when the Manitoba Agricultural College, under President Bracken, inaugurated training in Canadian Standard Efficiency Test leadership. Other colleges would do well to follow this lead and supplement it by propaganda of like character.

To summarize the main points: (1) Education needs Agriculture as a balancing co-ordinating factor. (2) This function corresponds to that which religious instruction exercises in other educational institutions, such as private schools, and organizations like the Y.M.C.A., etc. (3) Agriculture fulfills this function only when regarded as a means to an end rather than an end in itself, the end, in short, being responsible citizenship. (4) This movement must be carried on by young men and women—graduates from our agricultural colleges. (5) Graduates qualified to undertake the work must receive adequate training, for which it is necessary that the work be recognized and courses be adapted to this end.

This is really the greatest privilege and responsibility that agricultural colleges are faced with today. Properly administered it will place agriculture and home economics on a spiritual basis and we shall then have no further need to point out the intrinsic worth and honour of our chosen profession.

Sulphur and Soil Acidity.

W. A. DE LONG,

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That a condition of acidity may occur in soils has, of course, long been recognized. The production and regulation of such a condition by means of sulphur, however, is of comparatively recent origin. Such a use of sulphur has, none the less, become tolerably familiar to the agricultural world, particularly the technical section of it, during the past ten years or so. This has largely been the outcome of the work of Lipman *et al* of the New Jersey Agricultural Experiment Station.

The investigations of the workers mentioned have, to a large extent, been concerned with the production of soluble phosphoric acid in sulphur—floats composts through the action of the sulphuric acid produced by the oxidation of the sulphur by micro-organisms. The wide distribution of these sulphur oxidizing organisms in ordinary soils having been recognized (3) however, the tremendous importance of soil reaction to the growth of plants and to plant diseases, soon led to the further use of sulphur as a means of its control. As an outcome of the interest aroused in this direction, we have the use of sulphur suggested for the control of potato scab, which is, as is well known, produced by an organism, or group of organisms, which is sensitive to acidity of a certain degree.

That the reaction of the soil, and consequently the development of potato scab, can be controlled by this means, has been quite definitely shown. There are, however, as yet many points of practical importance with regard to the use of sulphur for this purpose which remain to be cleared up. As examples of such, the proper amounts of sulphur to be applied to different soil types, the best time of application, the necessity for inoculation, the effect upon subsequent acid-sensitive crops, such as clover, etc., may be cited. Hence there are still many experiments along this line being carried on.

With the object of ascertaining the requirements for optimum results under Nova Scotian conditions, some work has been undertaken at this institution by the departments horticulture and field husbandry with the operation of the department of chemist The writer has made the chemical tests cided upon and has found some results wh have been deemed of sufficient interest publication. A brief account follows.

In outline the project was to determ the effect upon the growth of the scab ganism, in soil known to be infested with of sulphur in the following amounts, 3 400, 500 and 600 pounds per acre. This w applied at three different periods, name four weeks before, at, and four weeks af planting the potatoes. The inoculated fo of sulphur was used in the main, but order to compare its effect with that of co mon sulphur (flowers of sulphur), a ser of the same amounts of the latter appl at the date of planting was included. T experiment was started in boxes in the gre house in January, 1922, and repeated or field scale with the opening of the seas The work is being continued the present ye both to confirm the results obtained, wh were somewhat unexpected in certain respe and to obtain further information. It is the more or less unforseen aspects of work that the writer wishes ot call attenti and, since these occurred more especially the greenhouse work, that part only of experiment will be dealt with here.

In somewhat greater detail the greenho conditions were as given below. The bo used contained a cubic foot each of thorou ly mixed and sifted soil, were manured w the same amount of fertilizer—to wit 500 l per acre of a 4-8-4 mixture made up fr nitrate of soda, acid phosphate and muri of potash—and were watered at the sa intervals with equal quantities of distil water. Further, each treatment was appl to three boxes and the acidity tests w made on composite examples taken fr them all. The sulphur applied was thorou ly mixed with the top four inches of the s in the boxes. In following the developm

TABLE I

No.	Treatment	Time of Application	Lime Requirement in Pounds of Limestone (of 90% purity) per Acre Feb. 1	Mar. 2	Mar. 30	Apr. 26
	Original Soil		3940			
A.	300 lbs. inoculatd sulphur	4 weeks before planting	4600	5400	5780	4640
B.	400 " " "	" " "	4800	6340	7100	6140
C.	500 " " "	" " "	5600	6320	7440	6180
D.	600 " " "	" " "	5600	7120	7440	6420
E.	No treatment		3940	3440	4180	4120
F.	300 lbs. inoculated sulphur	at planting		5420	8260	6120
G.	400 " " "	"		7040	9080	5820
H.	500 " " "	"		8380	10000	8040
I.	600 " " "	"		7800	8380	6240
J.	300 lbs. ordinary sulphur	"		6240	5980	5400
K.	400 " " "	"		7020	9080	6080
L.	500 " " "	"		7440	9180	5720
M.	600 " " "	"		9320	10200	6820
N.	300 lbs. inoculated sulphur	4 weeks after "			7660	5320
O.	400 " " "	" "			9680	6760
P.	500 " " "	" "			9680	7620
Q.	600 " " "	" "			8580	6140

of acidity determinations of the lime requirement were made at monthly intervals by the Jones calcium acetate method. The results obtained, which were calculated to a moisture-free soil basis for comparative purposes are given in Table I.

Examination of these results shows that there was a marked increase of acidity in all cases where sulphur was used. It is also seen that the amount of acidity produced increased with the amount of sulphur applied quite regularly up to 500 pounds, beyond which amount an increase sometimes did, and sometimes did not, produce an increase of the lime requirement. Further, the uninoculated form produced as great acidity as the inoculated. In addition it is interesting to note that the maximum lime requirement is obtained in every case at the second test, or about eight weeks after the planting of the potato setts.

In order to indicate somewhat more clearly to just what extent the acidity was increased, the average value of the maximum lime requirements attained by each of the amounts of sulphur used is given.

Since the check boxes were treated in all respects similarly to the others, with the exception that they received no sulphur, the conclusion that the increase of acidity shown by the increased lime requirement was due,

TABLE II.

Treatment	Maximum Lime Requirement	Increase
300 lbs. inoculated sulphur	7234	3054
400 " " "	8620	4440
500 " " "	9040	4860
600 " " "	8140	3960
300 lbs. common sulphur	5980	1800
400 " " "	9080	4900
500 " " "	9120	5000
600 " " "	10200	6020
No treatment	4180	

directly or indirectly, to the sulphur applied, would seem to be justified.

Being satisfied then that there was an increase of acidity attributable to the sulphur, the question arises, to what extent would the sulphur need to be oxidized in order to produce an equivalent lime requirement to that shown by our tests? In other words, assuming the acidity to have been produced by oxidized sulphur as a result of the activities of sulfofying bacteria, how efficient have these bacteria been, and what percentage of the sulphur have they oxidized? Now if the sulphur is assumed to be oxidized to the form of sulfuric acid, and the acidity is measured in terms of calcium carbonate, a simple chemical calculation will furnish the necessary data for answering these questions. Proceeding on these assumptions, the chemi-

cal equations for which may be written as follows:

$2S+3O_2+2H_2O$ sulfofying bacteria $=2H_2SO_4$

$H_2SO_4+CaCO_3 = CaSO_4+H_2O+CO_2$

It is seen that 32 pounds of sulphur, when oxidized to sulphuric acid, requires 100 pounds of pure (or 111 pounds of 90 per cent.) limestone for neutralization. The amounts of limestone of 90 percent purity required to neutralize the sulphuric acid, which the various amounts of sulphur used would produce if oxidized as has been assumed, along with the amounts actually required to neutralize the acidity present, and the differences between the theoretical maximum and the actual amounts required are shown below.

TABLE III.

Amount of Sulphur Used	Theoretical Amount of Limestone Required to Neutralize the Acid	Actual Increase in Lime Requirement	Positive Difference
300 lbs.	1041	2740	+ 1699
400 "	1389	4554	+ 3165
500 "	1736	4896	+ 3160
600 "	2083	4470	+ 2387

Note: The increases given above are the average for all applications of a given amount of sulphur.

Now it is quite evident from a consideration of the above that oxidation of the sulphur applied could not in any case account for all the acidity produced as shown by the increase in lime requirement. How then may the surplus acidity, if one may style it such, be accounted for? Certainly not by the effect of the crop given, the fertilizer applied, or the greenhouse conditions, although each of these factors may exercise an important influence upon soil acidity (1), (4), since these conditions were the same for the boxes receiving no sulphur as for those to which it was applied. It is possible of course, but hardly probable, that the sulphur may have caused the plants to produce greater quantities of acid than they ordinarily would do. Or, it is possible that there may have been some effect upon the bacterial population of the soil and its activities. Of these possibilities the second seems to be the most promising and finds some support in the work of several investigators. For example, Fred and Hart of Wisconsin have found (2) that applications of gypsum increase th evolution of carbon dioxide from soil; a indication that the activities of the organism producing decay of the soil organic matte are speeded up by the use of this sulphur carrying material. O'Gara, also, noted (5) a decided and consistent increase in tota bacterial numbers as determined by the plat method as a result of the application of sul phur to field and truck crops. On the othe hand, however, Pitz (6) and Tacheuchi (7) have found that sulphur does not increase and according to the former may even de crease, the number of soil bacteria.

The evidence on this interesting point i thus seen to be somewhat conflicting, and i would seem to the writer to be a matte worthy of being cleared up, to which en some further work is proposed. This will however, be entirely of a chemical nature and further information upon the bacterio ogical aspects of the problem would seem to be of interest and value in connectio with the further use of sulphur as a mean of regulating the acidity and reaction of th soil.

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The Winter Course in Agriculture at Macdonald College.*

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At Macdonald College courses leading to he degree of B.S.A. are offered in Agronomy, Animal Husbandry, Entomology, Horticulure and Plant Pathology. The training given aims to fit men for teaching, investigation, xtension, and administrative positions in Agriculture. The entrance requirements are matriculation or its equivalent and a limited mount of farm experience, with modifications thereof to meet the cases of men with reater age and experience. The studies for he first two years include the sciences, with limited amount of time given to the agriultural subjects to maintain contact and interest; while those of the last two years are argely made up of the agricultural subects, along with the application of the ciences. While these courses are important n their place, only a small proportion of he graduates undertake farming. Some provision is made for a choice of subjects that re more or less suited to the man who inends going back to the farm, but the courses for the most part are built around specialzed branches of agriculture, and are not rimarily intended for those returning to the and. Moreover, the entrance requirements ender such a course impossible for many nen who wish to take up practical farming. Even if this were not a difficulty, it is hardy to be expected that all, or a large proportion of farm boys, would take a full fourear course. They could not if they would, nd they would not if they could. From the tandpoint of training men for the farm there s here a wide gap in the educational system.

Difficulties that must be given consideraion in connection with the subject in this rovince are those of getting a high school ducation, and the unsuitability of the eduation given, for a farm boy. There are in the rovince of Quebec about thirty high schools rom which matriculation can be obtained y the English speaking population of the ural districts. These are largely located in the towns and villages. Five miles is probably the limit within which a boy can board at home and attend school. Boys living at a greater distance than this have to bear the expense of board and room in a town or village. These expenses, together with tuition fees, may easily run to three or four hundred dollars per year. This means that only at a high cost can a very large proportion of boys get a high school education.

Apart from the difficulty of expenses, there is the additional one, namely that the high school courses are not planned to serve the needs of the farm boy in particular. Much time is very often spent in studying subjects from the viewpoint of preparation for university courses, rather than from that of farm life. It is true that at some of the high schools courses in Chemistry, Physics and Botany are given. Even these, however, are generally put on without any bearing to the farm. This means that, aside from courses leading to a degree, there is a definite need for agricultural courses designed for boys who want to return to the farm, irrespective of whether or not they have graduated from high school.

For this purpose the Winter Course in agriculture has been developed to meet the situation in part measure. The course starts on November 1st and continues to March 15th, and thus includes about four months of actual study. This allows a boy to take the work when he is least needed at home. It is essentially practical in character, and aims (1) to give the largest amount of training and information in the shortest possible time, (2) to equip the farmer for solving his own farm problems, (3) to awaken him to the many opportunities on the farm, (4) to give him an inspiration along agricultural lines, and (5) to enable him to fill a more

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useful place in rural citizenship. There are few restrictions as to entrance. The candidate must have passed his seventeenth birthday, must have some farm experience, and must be able to read and write the English language acceptably. By far the greatest amount of time is given to the practical subjects, including Agricultural Engineering, Agronomy, Animal Husbandry, Farm Management, Horticulture, Poultry and Veterinary Science. The following topics will serve to illustrate the character and scope of the work that is given:

The choice and planning of a farm.
The equipment of a farm.
The capital required.
The factors of size and diversity of farming.
The stocking of a farm.
The value of drainage and how to accomplish it.
Planning a rotation for a farm.
Methods of handling manure.
The use of fertilizers and lime.
The use of green manure crops.
Tillage in relation to the various factors of crop production.
The best practices in growing hay, grain and fodder crops.
The production of clover seed.
Sources of seed and preparation for seeding.
The harvesting and storing of farm crops.
Treatment of crops against diseases.
The control of weeds.
The suitability of feeds for different classes of stock.
The purchase of feeds and how to combine them for greatest profit.
The feeding of stock.
The choice of sires and dams for breeding purposes.
Judging and selection of animals for different purposes.
The care and handling of all classes of stock.
Housing and stabling.
The operation and care of farm machinery.
The operation of gas engines and tractors
Blacksmithing and repairing of farm machinery.
Carpentry and the use and care of tools.
Farm building construction.
The use of concrete for making floors fence posts, foundations, etc.
Fence construction.
The study of farm building construction from the standpoint of efficiency, economy, convenience and permanence.
Water supply on the farm, including sources, methods of pumping and storage
Heating, ventilating, and lighting of farm buildings.
Sewage disposal.
Causes, symptoms and first aid treatment of the most important diseases and injuries of stock.
The farm vegetable garden.
The improvement of home surroundings
Planting and care of trees, flowers and shrubs.
The farm woodlot.
Farm poultry keeping, including winter egg production and the housing of poultry.
The care of milk, testing, separating and butter making, etc.
The marketing of farm products.

In addition to such work as this, other subjects of vital interest to the farmer are included. Two lectures per week are given such subjects as co-operation, business organization, banking, rural credits, taxation, tariff, law, and rural life problems. Three lectures per week are given on English composition, letter writing and public speaking.

There may be room for question as whether the course should not be extended a two year course or even longer. There can be no doubt, however, that the practical information and training given in the four and a half months fit a man better to solve his farm problems with greater profit and satisfaction to himself, and with advantage to the community.

Fermes Fédérales de Démonstration.

J. H. TREMBLAY

Inspecteur des Fermes Fédérales de Démonstration,

Ste. Anne de la Pocatière, P.Q.

Origine.

Le travail de démonstration, inauguré epuis plusieurs années déja par la Commis-ion de Conservation, passa en 1914 sous e contrôle d'une division nouvelle dite: Fermes de démonstration."

Quelques fermes furent choisies cette ême année, surtout dans les provinces de askatchewan et d'Alberta où les travaux de émonstration commencèrent dès le prin-emps suivant.

En 1915, ce genre de propagande des onnes méthodes culturales s'introduisit dans province de Québec et se développa d'une nnée à l'autre, s'étendant à toutes les pro-inces de sorte qu'aujourd'hui, une centaine de ermes fédérales de démonstration opèrent à ravers le Dominion un travail éducatif ap-réciable.

Site et Fonctionnement.

Ces fermes, étant les intermédiaires pour iffuser parmi les cultivateurs les résultats 'expériences faites aux fermes expérimen-les, doivent être d'accès facile pour tous; onséquemment, elles sont toujours situées le ong d'un chemin public et divisées de anière à y faire aboutir chaque sole de rotation, afin que les méthodes de culture ient mises en évidence.

Dans la province de Québec, les fermes e démonstration varient de huit à vingt cres, tandis que dans l'Ouest elles s'étendent ême jusqu'à soixante-quinze acres. Leur ut, de maintenir et d'augmenter la fertilité es sols, par contre d'augmenter le rende-ent des récoltes tout en diminuant le coût e production, peut être atteint en adoptant n système de rotation variant avec les exi-eances de chaque contrée.

En ce qui concerne l'Ouest, la rotation ivant de trois ans est très en vogue.

lère année: Jachère d'été.

2ième année: Grain blé(ou avoine) sur achère.

3ième année: Grain (blé ou avoine) après rain.

Dans les régions de l'Est, une rotation de quatre ans, répondant aux besoins de l'indus-trie laitière, est préférable. On procède comme suit:

lère année (blé d'Inde, Choux de Siam, Soleil, etc.)

2ième année: Grain (avoine ou blé) avec à l'acre, 10 lbs. de mil, 8 lbs. de trèfle rouge, 2 lbs. de trèfle alsique.

3ième année:Foin de trèfle.

4ième année: Foin de mil suivi d'une demie jachère.

Cette rotation fournit amplement de four-rage grossier et succulent, indispensable dans l'alimentation des vaches laitières. Les pro-priétaires de fermes de démonstration désir-ant améliorer leur troupeau autant que leurs champs, font le contrôle laitier.

Seul le grain de semence choisi et traité pour prévenir le charbon, est employé. On sème la graine de trèfle et de mil à forte dose, le rendement dépendant de la quantité semée. "On récolte ce qu'on sème "dit le proverbe, et il ne ment pas.

La jachère que l'on pratique, est d'une grande valeur dans la destruction des mauvaises herbes, notamment du chiendent. Elle permet d'emmagasiner plus d'air et d'eau, elle active la décomposition des matières organiques, en humus, partant augmente le pouvoir de retention, rend les sables plus consistants et les terres fortes plus perméables.

Résultats.

Le cultivateur possédant ces champs de démonstration, travaille sous la direction du Ministère Fédéral de l'Agriculture, de la manière la plus pratique, sans frais addition-nels. Dès les premières années, il constate la plus grande fertilité de son terrain et l'abon-dance de ses récoltes amène généralement ses voisins, coparoissiens et autres à l'imiter.

Voici quelques résultats obtenus en 1916. sur des fermes de l'Ouest, en comparant la méthode ordinaire "Grain sur Grain" à celle de "Grain après Jachère."

	Grain sur Grain	Grain sur Jachère
Pambourn, Sask.	18 mts. à l'acre	36 mts. à l'acre
Prelate, Sask.	20 " "	40 " "
Maple Creek, Sask.	31 " "	42 " "
Foremost, Alta.	33 " "	50 " "
Bow Island, Alta.	27 " "	48 " "
Magrath, Alta.	36 " "	59 " "

Pour une rotation de quatre ans dans l'E on comparera les rendements de premiè année d'opération d'une ferme à ceux deuxième cycle de la rotation.

NEW CARLISLE, QUÉBEC

	1917	1921
Champ A—Patates à l'acre	110 minots	230 minots
" B—Avoine "	31 "	53 "
" C—Foin "	1 Tonne 300 lbs.	2 Tonnes 1000 lbs.
" D—Foin "	1 " 300 "	1 " 1000 "

Ces données démontreront la valeur des méthodes préconisées sur les fermes de démonstration, quitte à chacun de tirer conclusion.

Jardins Paysagers et Florifères.

ERNEST PINTAL,

Rimouski, P.Q.

Il me semble que parler de jardins paysagers ou florifères, en un temps où tous les efforts tendent à la production sous toutes ses formes, des choses nécesaires à la vie, est une dissertation pour le moins oiseuse, et n'aurais-je pas dû écarter de suite cette pensée pour une autre plus pratique?

Pourtant l'idée m'en est restée, engageante même, à raison du triple but qu'elle peut atteindre: rendre plus agréable le séjour au foyer, augmenter la valeur de la propriété en l'embellissant, attacher la famille au toît paternel. N'a-t-on pas dit cent fois qu'une des principales causes qui a ouvert le chemin de l'exil volontaire de tant de nos compatriotes aux Etats—Unis, c'était précisément ce manque d'attrait au foyer domestique, l'absence de ce qui pouvait égayer l'âme et donner au corps un repos mieux goûte?

On se sent irrésistiblement attiré à admirer une jolie résidence qui se dessine fraîche et coquette au milieu de beaux grands arbres, qui émergent comme au sein d'une oasis où le goût a créé des paysages enchanteurs. Au contraire, devant une demeure où rien ne révèle le goût du beau, où la nature semb réduit à l'état quasi sauvage, le passa attristé semble se dire: Quelle misère, qu isolement!

Un payage floral, aux abords d'une jo résidence, peut cacher bien des tristesse mais l'impression qui en reste est toujou agréable et il est bien rare que lorsqu' prend ce soin particulier d'embellir s "Home", la misère est loin de la porte qui s'ouvre que sur le bonheur.

N'est-ce pas une raison suffisante po m'engager à traîter ce sujet, succintenteme mais avec le plus de précision possible?

Le jardin floral est à l'amour du toit p ernel ce que le jardin scolaire est à l'amo de l'agriculture; tout deux sont des init tions à l'attachement au sol. De ce seul ch ils ont un but patriotique qui, s'il ne co tribue pas à la sustension de la vie, a né moins le charme de l'embellir.

N'est pas en outre l'exquise nature q l'on trouve dans la culture des fleurs?

Cette culture est devenue un art, telleme que les véritables amateurs de cet art cl

nt aujourd'hui leur oeuvre d'après le div- s genres d'architecture que l'on appelle:

Styles

Le style est donc un genre adopté dans création des jardins floraux, ou, si l'on ut, la disposition des plantes d'après un an reconnu. Le plan, on le suppose bien, it tenir compte des genres de plantes que n veut cultiver. Son application dépend aucoup du goût et de la formation intel- tuelle que l'on a reçue.

On peut done établir trois styles dif- rents: le style que j'appellerai *naturel*, le le *architectural* et le style *pittoresque*. quel est le plus admirable? Dans chacun ur genre, tous trois le sont, mais à des res différents, comme nous le verrons dans s quelques remarques qui vont suivre.

Style Naturel.

Le style naturel est aussi appelé style *glais*, parce qu'il a été d'abord adopté en gleterre. C'est le plus suivi de nos jours ce n'est pas le moins gracieux. La nature des secrets que l'art ne possède pas. C'est écisément celui que je conseillerais surtout ns la création d'un jardin florifère pour rnementation d'une résidence de ville o lle d'une ferme.

Ce style est une imitation de la nature un n capricieuse. Dans ce style, tout est ne courbes: bordures, entrées, chemins. Le ntre du terrain, sans aucune plantation, est base de ce style. La plantation d'arbres d'arbustes forme la limite du terrain.

Les bâtisses sont construites plutôt de côté e dans le centre du terrain.

Les entrées, chemins et trottoirs sont local- s, autant que possible, de chaque côté du rain.

Les entrées, chemins et trottoirs sont local- s, autant que possible, de chaque côte du rain.

Les lignes droites, n'étant pas naturelles, sont pas admises; toutefois, il faut parfois re violence à l'art et introduire quelques nes droites, surtout lorsque les lignes urbes ne sont pas justifiables et ne vien- nt pas naturellement.

Les arbustes et les plantes grimpantes urront unir la maison au terrain voisin. Pas d'arbres rangés, mais plutôt irrégulière- ment disposés.

Tout en cherchant à imiter la nature, ce style ne doit pas en forcer la note, surtout dans ce que la nature a d'excentrique, de non imitable. En l'obervant, on ne manque pas de trouver de beaux paysages qui peuvent être imités. C'est véritablement en cela que consiste le style naturel.

Style architectural.

Le style naturel tient son nom de la na- ture; on peut en dire autant du style architec- tural, mais dans un sens un peu plus corsé. Ainsi ce style n'a pas du tout l'architecture pour base mais, par un hasard assez étrange, il doit son nom au fait que les premiers plans de ce genre ont été faits par des archi- tectes qui ne connaissaient pas un traître mot de la floriculture.

Tout de même, le style est resté et en Italie surtout, il est tellement à la mode qu'on a travesti son nom en celui de style italien. Ce style est généralement adopté dans la création des parcs publics. Le Floral Park de New York est un chef-d'oeuvre du genre.

Dans ce style, on a le culte des lignes droites; plates-bandes, bordures, entrées sont toutes en lignes invariablement droites et d'une régularité parfaite. C'est l'art, quoi.

Des haies d'une culture parfaite encadrent les parcs et les divisent avec une symétrie irréprochable.

Le gazon, les pelouses y sont toujours rasés et frais. Leur verdeur semble éternelle, comme autour le la grotte de Calypso.

On voit dans ces parcs, disposés ça et là avec un chic enlevant, des urnes, des fon- taines automatiques et tout ce que l'art, dans l'exquis et le beau, peut ajouter aux beautés de la nature.

Il ne faut pas parler de ces beautés dis- pendieuses dans les campagnes, ce serait por- ter un coup de mort au style architectural.

Style Pittoresque.

Le style pittoresque consiste dans l'imita- tion de la nature, mais seulement dans ce qu'elle a d'accidenté, d'excentrique. On voit dans ce genre des imitations réellement grand- ioses.

Le pittoresque n'a pas de loi et il serait bien difficile d'en déterminer qui régissent ce style. Il faut un choix bien judicieux d'arbres et d'arbrisseaux pour imiter le pittoresque naturel; on y recherche les couleurs sombres.

Ce style n'est possible que lorsque le terrain s'y prête naturellement. Vouloir faire du pittoresque dans nos jardins ordinaires serait une tentative ridicule.

Plan du Terrain.

Un jardin paysager ne s'établit pas au hasard. On peut bien, lorsqu'on n'a qu'une étendue limitée à attribuer au jardin, disposer facilement et sans méthode préconçue, du terrain qui ne se prête pas beaucoup d'ailleurs, ni au style pittoresque, ni au style architectural. On suit alors un style que je pourrais appeler familier, qui a pour base le bon gôut.

Mais on veut faire quelque chose d'extra.

On doit se rendre compte alors, si ce paysager est plutôt *pour soi*, pour sa famille, que *pour le public.*

Si c'est pour son agrément personnel, indispensable est la haie qui séparera le paysager de la voie publique.

Cette haie, on la fera d'aubépine, d'accacia ou de spirées. Notons de suite que ces haies ne sont belles que si elles sont parfaitement entretenues et bien taillées, du moment qu'elles sont arrivées à la hauteur désirable.

J'excepte cependant le spirées, qui ne conservent leur grâce et leur charme que si elles gardent leurs branches intactes. On en enlève seulement les branches superflues. Donner aux haies de spirées une apparence de rasure faite à équerre est un hors-d'oeuvre que n'autorise aucun amateur de belles haies. Elle n'a plus alors aucun sens et est exposée à se dessécher, comme honteuse d'elle-même.

Le paysager dont on veut ménager au public le gracieux et élégant aspect, n'a pas de haies à sa devanture. Celles-ci peuvent bien comme l'encadrer de côté, mais rien ne doit en intercepter la vue. Une petite palissade ornementale en broche, si la clôture en fer orné et à jour est trop dispendieuse, séparera le paysager du chemin public.

On aménagera dans le paysager les arbustes, les plantes vivaces et les plantes annuelles, d'après un plan préconçu et bien dét miné, graphiquement; c'est le plus sûr.

Ce plan précisera l'étendue du jardin, site de la maison et de ses dépendances; allées, les arbres, les arbustes; la nomenc ture des diverses plantes à disposer, arb tes, plantes vivaces, annuelles. Tout s indiqué et arrangé au préalable, de te sorte qu'arrivé le moment de la plantation, n'y ait ni hésitation, ni retard.

Pour un emplacement de ville ou sub bain, j'estime beaucoup la maison située côté plutôt qu'au centre du terrain; ce disposition donne plus d'espace, ombra moins le terrain et permet de mieux l'utilis On réserve à l'arrière ce qu'il faut pour cours nécessaires; aucune parcelle de terr n'est perdue et on peut disposer avec p de facilité les diverses plantes que l'o distribuées, grimpantes et autres.

Les combinaisons que l'on peut faire pendent absolument du site; il serait ois de les décrire ici.

A la campagne, la maison doit é éloignée du chemin au moins de trois sa hauteur.

L'architecture en varie la forme, a bienque les commodités que l'on veut av

Il me paraît indispensable d'avoir q ques beaux gros arbres autor de la réside de campagne.

Les arbres sont l'ornement indispens des jardins paysagers à la campagne même lorsque tels jardins n'existent pas, beaux grands arbres sont toujours un ma tueux ornement que l'on admire. Ils doi être les premiers choisis et les prem placés.

Une plantation permanente d'arbustes l choisis, une haie bien disposée et bien en tenue, des bordures d'arbustes de differe tailles et couleurs, d'une plantation plus moins irrégulière qui ornent les côtes allées, des bordures de plantes vivaces leurs touffes forment des corbeilles de f lage toujours vert, toujours charmant, o plèteront le jardin, rendront les abords la maison plus attrayants, en feront un "s home" c'est-a-dire le séjour des joies exq où le lendemain sourit toujours ou jour l'a précédé.

Necessité du Sens Social.

A. DESILETS,

Ministère de l'Agriculture, Québec, P.Q.

Celui qui écrit ces lignes a une horreur profonde du scialisme. Le bolchévisme et la révolution ont ensanglanté le monde et noirci de ruines le vieux sol européen. La Russie a donné dans le pire des socialismes par qu'elle a manqué de vrais sociologues. La sociologie bien inspirée enseigne les principes de l'ordre et de la soumission raisonnée aux droits de l'autorité et aux devoirs du citoyen. Celui qui a le sens social aime ses frères, ses voisins, ses semblables, et leur rend les devoirs de charité et de solidarité qui sont dûs à ceux avec qui nous vivons en société.

L'égoisme est la plaie la plus funeste de notre temps, et c'est par elle et à cause d'elle que tant de misères physiques et morales nous entourent. Si les hommes s'aimaient entre eux, la paix aurait vite fait d'équilibrer les différences de fortunes et de situations en allégeant le fardeau des uns et en rendant plus agréable l'accomplissement des devoirs du riche et du puissant envers le pauvre et le petit.

Nous vivons en société et nous n'avons pas le droit d'oublier que nous nous devons les une aux autres, que nous sommes solidaires, que nous devons nous aider, nous conseiller, nous secourir, nous parler plus coeur à coeur. C'est le principe même de toute vie de communauté dans le monde comme dans le cloître.

D'autre part, on oublie que l'esprit des sociétés, des groupements sociaux, n' a d'autre but que d'unir les efforts, les talents et les ressources de chacun en vue du bien de tous. Les fins pour lesquelles un certain nombre d'hommes s'unissent ressortent d'une oeuvre à accomplir, d'un idéal à atteindre. C'et le cas de l'Association des Techniciens en Agronomie, comme de toutes autres associations.

Mais, il y a des intéressés qui dédaignent ce moyen d'avancer leurs intérêts, qui ne lui accordent qu'une faible confiance, parce-qu'ils n'ont pas pris la peine d'approfondir d'abord le principe de l'union professionnelle. Ils ne cherchent en premier lieu qu'un revenu argent ou honneur. Si ce revenu de leur apparaît visible et présent dès leur entrée dans le groupement, ils perdent confiance en l'efficacité de l'Association et se disent qu'il ne sert de rien d'y appartenir.

Or, telle association d'hommes n'apporte tous ses avantages qu' à ceux qui ont le sens social bien développé, qui aiment à marcher main dans la main avec leurs confrères et qui sont prêts à aider ceux qui sont dans le besoin. Le trésor de l'aide mutuel et confraternel est proportionné, dans sa richesse, au nombre des confrères et à leur sens social bien développé. Je connais peu d'hommes qui aient été heureux s'ils n'ont pas su s'intéresser à la vie de leurs semblables, au bonheur et aux succès des autres comme à leurs difficultés et à leurs infortunes. En outre, le dévouement confraternel contribue au perfectionnement de la compétence professionnelle. Et si chacun des membres d'une Société comme la nôtre aimait son association, il travaillerait à se perfectionner lui-même afin d'aider au perfectionnment de tous.

Nous avons une mission considérable à remplir au près de la classe agricole dans l'enseignement et la direction technique de l'exploitation culturale. Notre association contribue à nous faciliter les moyens d'accomplir cette mission et à édifier l'autorité qui nous est indispensable pour le succès de cette mission. Ne l'oublions pas, tout est là.

Concerning the C.S.T.A.

GRADUATE SCHOLARSHIPS.

The Quebec Department of Agriculture has placed at the disposal of the C.S.T.A. a scholarship of $600.00, to be awarded to a resident of the Province of Quebec. The successful applicant will be chosen by a Credentials Committee which will be appointed at an early date.

The advertisers in *Scientific Agriculture* will award a second scholarship. This is made possible by an advertising surplus in the magazine.

It is hoped that further scholarships will be assured before the convention opens.

The names of those to whom the C.S.T.A. scholarships are to be awarded will be announced at the Saskatoon Convention.

Anyone wishing to contribute to the Graduate Scholarship Fund should write to the General Secretary of the Society.

NEW C.S.T.A. BRANCH SUGGESTED.

During the past month the organization of a Northern Ontario Branch of the C.S.T.A. has been suggested, and enquiries are now being made to ascertain the desirability of acting upon the suggestion.

There is a small group of agricultural graduates in this section of Ontario—at Port Arthur, Fort William, Monteith, Kapuskasing and other points. Their nearest local branch (Western Ontario) usually holds meetings at Toronto or Guelph and it is impossible for those situated in Northern Ontario to attend. The result is that few have joined the Society, and it is these eligible members who have suggested the organization of a new branch which could hold meetings at points that were within easier reach.

The General Secretary of the Society is arranging to attend a meeting at Port Arthur on June 13th in order to discuss with agricultural graduates the question of organization.

CONVENTION PROGRAMME

The official programme of the convention is now being printed and will be ready for distribution about June seventh to all official delegates and others who are planning to attend the Saskatoon meetings. It is embodied, in almost complete form, in the following two pages of this issue of the magazine.

NOTES

Dr. M. A. Jull (O.A.C. '08) in charge of the poultry department at Macdonald College, has recently been appointed Chief of the Poultry Division in the U. S. Dept. of Agriculture at Washington. He leaves Canada on July 1st to take up his new duties.

Mr. Arthur Gibson, Dominion Entomologist, sailed from Quebec on May 26th to attend an International Conference on Economic Entomology which is being held at Wageningen, Holland, during the last week in June.

Mr. P. M. Daly (Macdonald '21), who has been doing graduate work at the University of Minnesota during the past winter, is occupying a temporary position in the Horticultural Division at the Central Experimental Farm, Ottawa.

F. F. McKenzie (B.C. '21) has completed his M. S. course at the University of Missouri in Animal Husbandry. His immediate plans are uncertain.

E. C. Stillwell (O.A.C. '19), has received his M.S. in Animal Husbandry at the Iowa State College. He expects to visit Canada this summer.

Dean F. M. Clement of the University of British Columbia is planning to attend the Saskatoon Convention.

President L. S. Klinck of Vancouver addressed the members of the Eastern Ontario local at Ottawa on May 22nd.

J. A. Ruddick, Dominion Dairy Commissioner has recently returned to Ottawa after spending three months in an enquiry into the dairy industry in Australia and New Zealand.

The General Secretary is arranging to meet members of the C.S.T.A. at Winnipeg on June 14th and at Regina on June 15th in order to discuss some of the business matters that will be introduced at the Convention.

THE SASKATOON CONVENTION.

The Third Annual Convention of the Canadian Society of Technical Agriculturists opened at the University of Saskatchewan, Saskatoon, on June 20th and ended on June 23rd. It was preceded by the Annual Meeting of the Canadian Seed Growers' Association—also held at the University of Saskatchewan—and followed by a Conference of (western) Dominion Experimental Farm Superintendents at Scott, Sask. This series of meetings proved to be a very satisfactory arrangement and, so far as the C.S.T.A. Convention was concerned, it enabled a number of members from distant points to attend.

As in previous Conventions, there was an apparent enthusiasm, and a local increase in membership. Particularly noticeable, however, was the serious consideration given to the business meetings of the Society, and the great interest which was shown by men prominent in all divisions of professional agriculture. There were no doubts expressed as to the future usefulness of the Society, and no criticisms of the manner in which it had functioned up to the present time. This attitude of confidence and pride may be accepted as a favourable indication of future development and prosperity.

Extremely unfavourable weather interfered with the carrying out of some of the social events featured on the official programme. The motor trips to Sutherland and Nosthern were cancelled; very few members attempted to visit the experimental plots, and only those who were extremely venturesome patronized the golf links and tennis courts. Rain was almost continuous throughout the Convention, but the realization of its value to western farms prevented any discouragement or depression.

In spite of this obstacle, there were ample opportunities for recreation and relaxation. The banquets given by the University on the 20th and by the Provincial Government on the 22nd were features of the Convention. Excellent addresses were given by President W. C. Murray, Dean W. J. Rutherford, Hon. C. M. Hamilton and Mr. F. H. Auld. Since the latter address dealt particularly with a question being carefully considered by the Society (Agricultural Policies), it will be published in complete form in next issue. Other addresses of an informal character were given by Prof. M. Champlin and Mr. C. M. Learmonth, representing the North and South Saskatchewan branches of the Society; and by Mr. G. H. Clark, Dominion Seed Commissioner, who represented the Dominion Minister of Agriculture at the luncheon on June 22nd.. The University Dance and Bridge on June 21st was extremely well arranged and was thoroughly enjoyed. The greatest credit is due to the local committees, under the chairmanship of Messrs. Champlin, Gordon and Rayner, which were responsible for the arrangement of the social parts of the programme.

The live stock show provided by Professor A. M. Shaw deserves special mention. Commencing with an exhibition of horses in the judging arena, the members were able to see all the different classes of stock at the University and Professor Shaw, in the two hours at his disposal, gave a very comprehensive account of the development of this important department of the Agricultural College and of the work which is being carried out under his supervision.

The series of graduate lectures provided by the Dominion Department of Agriculture occupied three afternoon sessions. The Society was fortunate in securing such outstanding men as Dr. F. J. Alway, Dr. H. K. Hayes, Dr. A. J. Pieters and Dr. W. W. Swanson, who lectured respectively on Soils, Cereal Crops, Forage Crops and Economics. In order that all members may have an opportunity of benefitting from these lectures, it has been decided to publish those of Dr. Pieters, Dr. Alway and Dr. Swanson in the next issue. The lectures given by Dr. Hayes were accompanied by important lantern slides and cannot be arranged for publication.

In the following pages will be found the reports of Standing Committees, the Presidential address, the report of the General Secretary, the personnel of all committees for the year 1923-24, a list of those who registered, a list of Resolutions and much other

THIRD ANNUAL CONVENTION, C.S.T.A.

Some of those who met at the University of Saskatchewan, Saskatoon, June 20 - 23, 1923.

FRONT ROW, left to right: J. F. McLean, Saskatoon; C. M. Learmonth, Regina; L. E. Kirk, Saskatoon; L. S. Klinck, Vancouver; W. J. Rutherford, Saskatoon; L. H. Newman, Ottawa (Honorary Secretary); E. A. Howes, Edmonton, (Vice-president); H. Barton, Macdonald College, P.Q., (President-elect); J. B. Reynolds, Guelph, Ont., (retiring President); W. C. Murray, President of University of Saskatchewan; Fred H. Grindley, Ottawa, (General Secretary); G. H. Clark, Ottawa; H. A. Craig, Edmonton; M. Champlin, Saskatoon; W. H. Hicks, Agassiz, B.C.; K. W. Gordon, Saskatoon.

SECOND ROW: W. R. White, Ottawa; F. M. Clement, Vancouver; R. G. Newton, Invermere, B.C.; F. Foulds, Winnipeg; J. E. Blakeman, Winnipeg; P. Stewart, Ottawa; D. H. Galbraith, Vulcan, Alta.; G. M. Stewart, Calgary; M. N. Tompkins, Antigonish, N.S.; W. J. Squirrell, Guelph; F. J. Alway, St. Paul, Minn.; H. K. Hayes, St. Paul, Minn.; Jas. Murray, Medicine Hat; E. C. Hallman, Acadia Valley, Alta.; M. L. Freng, Lethbridge; W. P. Fraser, Saskatoon; W. H. Fairfield, Lethbridge.

THIRD ROW: E. G. Booth, Saskatoon; **A. E. Palmer, Lethbridge**; W. R. Leslie, Morden, Man.; J. M. Varey, Saskatoon; R. K. Baker, Saskatoon; Father Leopold, La Trappe, P.Q.; T. G. Bunting, Macdonald College; A. Leitch, Guelph; H. Saville, Regina; V. S. Asmundsen, Vancouver; A. E. Potts, Saskatoon; P. C. Kidd, Regina; F. H. Auld, Regina; J. W. Gibson, Victoria; W. H. McGregor, P.E.I.; A. W. Peterson, P.E.I.; R. Summerby, Macdonald College; J. H. Ross, Regina.

BACK ROW: W. Southworth, Winnipeg; W. E. Walker, Rutland, Sask.; J. Macgregor Smith, Edmonton; ———; G. G. Moe, Vancouver; ———; E. E. Brockelbank, Regina; W. A. Munro, Routhwaite; R. Newton, Edmonton; R. S. Kennedy, Montreal; A. M. Clow, Sault

formation arising out of the business meetgs.

Professor H. Barton of Macdonald Colge, President of the Society for the comg year, presided throughout the Convention ıd at the Dominion Executive meeting held on ıne 23rd. At the latter meeting, Fred H. rindley was re-appointed as General Sectary of the Society.

Reports of Standing Committees

The reports of the committees on Marketg Education and on Graduate Study, read to e Convention by A. Leitch and G. G. Moe spectively, are published in this issue in ıll.

The report of the Committee on Research, hich was presented by Dr. W. P. Thompson, ınnot be printed in complete form at this me. Considerable arrangement of tabulated latter is necessary and some important inrmation has not yet been obtained. The troduction to the report is published elsehere in this issue and the complete report ill appear later.

A similar difficulty prevents the immediate ublication of the report of the Committee n Educational Policies, presented by Dr. L. . Klinck. It has been considered advisable delay the publication of the complete reort until some re-arrangement of matter has een completed.

A synopsis of this report follows:

1. Relation of the College of Agriculture to the Department of Agriculture.
   To be entirely independent but to cooperate officially and formally.
2. Relation of the College of Agriculture to the Department of Education.
   To be directly responsible to the Minister of Education, or to the Lieutenant Governor in Council, through the Senate and the Board of Governors of the University.
3. Relation of the College of Agriculture to the Governing Bodies of the University.
   The same as that of any other Faculty of the University.
4. Relation of the College of Agriculture to the University as a Whole.
   The same as that of any other Faculty of the University.
5. Entrance Requirements for Degree Courses.
   (a) To require junior matriculation.
   (b) To make the High School Course a four years' one.
6. Entrance Requirements for Non-matriculants.
   (a) An Associate Course plus an intermediate year before entering the junior year.
7. Objects of the Degree Course.
   (a) To give such elements of a liberal education as shall fit the graduate for farming or for any related line of work where a college education is required.
   (b) To train men for post-graduate and research work.
8. Length of Time Required.
   (a) The extension of the undergraduate course from four years to five years.
9. Proportion of Time Devoted to Foundational and to Specialized Courses.
   (a) To devote a larger proportion of time to literary and basic science subjects.
   (b) To reduce the number of lecture periods and increase the time assigned for reference reading.
   (c) To discontinue requiring thesis.
10. Relation Between Lecture Periods and Laboratory Periods.
    (a) To emphasize, relatively, laboratory work.
11. Combined Courses.
    To adopt the principle of.
12. Reasons for Recent Changes in Courses and for Further Changes, if Any Are Contemplated.
    (a) To ensure that the student gets a sufficiently good knowledge of general agriculture before he begins to specialize.
13. Associate Courses.
    (a) To differentiate sharply as between Associate Courses and Degree Courses.

Special mention should be made of the reports of all standing committees. The members of these committees have all done a great deal of work during the past year, and have accomplished definite results. It was considered advisable to re-appoint all of these committees for another year.

No report was submitted by the Committee on Affiliations. This committee, during the past year, has made a number of enquiries with the object of obtaining expressions of opinion on the question of affiliations, but no results have been obtained. The committee strongly recommended that the Society should draw up a clear policy as to the basis upon which it will accept applications for affiliation. This will be considered at the first meeting of the Executive Council. The committee was re-appointed.

CONVENTION COMMITTEES

The following committees were named by the chair, and reported on the last day of the Convention:

RESOLUTIONS: E. A. Howes (chairman), M. N. Tompkins, J. W. Gibson, J. B. Reynolds, H. A. Craig.

NOMINATIONS: L. H. Newman (chairman), W. Southworth, A. Leitch, T. G. Bunting, M. Champlin.

CONSTITUTION AND BY-LAWS: R. S. Kennedy (chairman), V. S. Asmundsen, A. W. Peterson, P. Stewart, D. H. Galbraith.

SCHOLARSHIPS: L. S. Klinck (chairman), G. H. Clark, W. P. Thompson, Father Leopold, G. P. McRostie.

REPORTS OF LOCAL BRANCHES.

All local branches of the Society were represented at the Convention, with the exception of New Brunswick and Quebec City. The reports presented indicated, without exception, an increased interest, an improvement in the quality of local meetings and an assurance of continued development. Only two branches reported a decrease in membership, and in both cases the falling off was due to the removal of members to other locals. Substantial increases in membership were reported from Alberta, Western Ontario and Eastern Ontario.

Space prevents the publication of the reports, which were submitted to the Co vention by the following members:—

British Columbia—G. G. Moe.
Alberta—E. A. Howes.
N. Saskatchewan—K. W. Gordon.
S. Saskatchewan—R. W. Neely.
Manitoba—Frank Foulds.
W. Ontario—A. Leitch.
E. Ontario—W. R. White.
Macdonald—T. G. Bunting.
Montreal and Quebec—Father Leopold.
Nova Scotia—M. N. Tompkins.
Prince Edward Island—A. W. Peterson.

The General Secretary reported for Ne Brunswick.

AMENDMENTS TO BY-LAWS

The following amendments to the By-la of the Society were approved*:—

By-law I—Clause 1 deleted.
This change makes it possible for anyo with the necessary qualifications, to jo the Society, if accepted by the Membersh Committee. Formerly membership w restricted to Canadians.

By-law III, Clause 1—The word "hereafte deleted.

By-law V—Amended to read as follows: "T membership fees shall be $10.00 for t first year and $6.00 for subsequent yea of which $2.00 and $1.00 respective shall go to the local branch." Former the local branches received only $1.00 fr all fees.

By-law VII, Clause I—The following w added: "All valid nominations shall placed before the Ballot Committe which shall prepare from them such ballot as may best enable the members give a clear expression to their wish when voting. This ballot must be su mitted to each local branch ten days b fore being distributed."

By-law VIII, Clause 1, Subsection "e"—T words "on Conventions" changed to " the Ballot."

This provides for the Committee referr to above.

*Refer to C.S.T.A. Booklet, pages 56-63 incl.

law VIII, Clause 1, Subsection "h" chang-
d to "i" and the following inserted as
ubsection "h": "on Constitution and By-
aws."

This provides for a new committee to con-
ider all amendments to the constitution
nd by-laws suggested during the year.

law XI—The following words were ad-
ed to the second paragraph: "or that such
mendment is brought before the Conven-
ion by the Committee on Constitution and
By-laws."

The third paragraph was amended to read
s follows: "The General Secretary shall
orward copies of all amendments pro-
osed before May 1st, to the Secretary-
Treasurer of each local executive."

A further amendment, suggesting a uni-
m date for the payment of annual fees,
s introduced to the Convention, but in view
the narrow financial margin upon which
Society is operating, it was not consider-
advisable to make such a change at the
esent time.

AMENDMENTS TO CONSTITUTION

No amendments were made to the Con-
ution of the Society. A resolution that
further applications for associate mem-
rship be accepted after the 1924 Conven-
n, and that no applications for regular
mbership from non-graduates be accepted
er that date, was referred to the special
mmittee on Constitution and By-laws, and
l be brought up at the 1924 Convention.
the meantime it will be referred to all
al branches for their consideration.

NIFORM CONSTITUTON FOR LOCAL BRANCHES

At the 1922 Convention a Special Com-
ttee was appointed to consider the adop-
n, by all local branches, of a uniform
nstitution and By-laws, based upon that
the parent organization. In its report,
esented at Saskatoon, this committee sub-
tted a proposed uniform Constitution and
-laws. It was found, however, that some
nges were necessary, and it was considered
irable that it be referred to the committee
Constitution and By-laws so that, at the
24 Convenion, it would conform, in all
pects, to the Constitution of the Dominion
ciety and to any amendments which might
introduced at the 1924 Convention.

RESOLUTIONS

It is not considered advisable to publish all of the resolutions passed at the Convention, since further consideration and action on the part of the Dominion Executive is necessary in the case of a number of these resolutions. A partial list appears below, and a further list will appear in a later issue:—

That the date of receipt of papers by the General Secretary be stated when the said papers are published in *Scientific Agriculture.*

That the Society take steps to affiliate, provided such affiliation is feasible, with the British Association for the Advancement of Science, the Royal Society of Canada or such other prominent scientific societies as might be advisable.

That the C.S.T.A. either as a body, or through its branches, publish every year an AGRICULTURAL CALENDAR in which the most outstanding facts and findings of the laboratory man have been stated and properly interpreted for the benefit of the field.

RESOLVED: That this Society draw the attention of the Provincial and Federal Governments to the urgent necessity of providing additional facilities for research in veterinary medicine with a view to diminishing the enormous losses suffered annually by the farmers and stock breeders of the country through the loss of animals due to preventable and curable diseases.

RESOLVED: That the Canadian Society of Technical Agriculturists request the Dominion and Provincial Ministers of Agriculture and also University and Agricultural College Presidents to permit the various men engaged in Scientific Agriculture under their direction to attend composite Provincial or Regional Conferences called for the purpose of selecting and defining the most urgent research problems pertaining to their respective provinces or districts.

Resolved that the hearty thanks of the members and delegates assembled in the Third Annual Convention of the Canadian Society of Technical Agriculturists be tendered;

(1) To the Dominion Department of Agriculture for defraying expenses in con-

nection with the series of advanced lectures given during the Convention;

(2) To the Provincial Department of Agriculture for Saskatchewan for so adequately providing for entertainment expenses;

(3) To the University of Saskatchewan for providing such excellent accommodation and entertainment;

(4) To the various Standing Committees and especially to the Chairmen of these Committees for the valuable work done and the important contributions made in the interests of the Society.

THAT WHEREAS, the ten year period during which federal assistance to the Provinces was granted in support of agricultural education in accordance with the terms of the Agricultural Instruction Act of 1913 ended on the 31st of March last, and WHEREAS federal assistance for the purposes already defined in the said Act has been continued on a somewhat reduced scale and for the present fiscal year only, and WHEREAS, the assurance of continued assistance from the Dominion Government in support of agricultural instruction is essential to the establishing of considered and permanent methods of development along this line, and WHEREAS it is generally believed that any withdrawal of federal support in this direction will inevitably result in the total or partial abandonment of many lines of work of great benefit to the Provinces as well as to Canada as a whole, THEREFORE BE IT RESOLVED that the Dominion Government be urgently requested at its next session to enact such legislation as will ensure to the Provinces continued and generous financial support towards the furtherance of agricultural instruction.

AND FURTHER BE IT RESOLVED that a copy of this resolution be presented to the Honorable, the Premier of Canada and to the Honorable, the Minister of Agriculture.

RESOLVED that the members of the C.S.T.A. desire to put on record their appreciation of the industry and enthusiasm of the General Secretary and of the practical measures he has already taken to create a system of graduate scholarships for members of the Society.

FELLOWSHIP

For profesional distinction, the Soc conferred a Fellowship upon Dr. James Robertson of Ottawa. Dr. Robertson is known to all who are acquainted with development of agriculture in Canada. has occupied the positions of Dairy C missioner for Canada, Principal of Macd ald College, chairman of the Lands Bra of the Conservation Commission, Presid of the Canadian Seed Growers' Associati chairman of the Royal Commission on dustrial Training and Technical Educati and others. At present he is actively eng ed in connection with the work of the Scouts Association and the Canadian Cross Association, being Chief Commissio and President respectively of these two ganizations.

James W. Robertson, *LL.D., C.M.G.*

Dr. Robertson is the third member of C.S.T.A. who has been elected a "Fello similar recognition having previously b given to Dr. L. S. Klinck and Dr. C. Saunders.

1924 CONVENTION

It was unanimously decided to hold 1924 Convention at the Ontario Agricultu College, Guelph.

It is a fortunate coincidence that the y 1924 is the fiftieth anniversary of the est lishment of the O.A.C. in 1874, so that occasion of the C.S.T.A. Convention w provide an opportunity for a re-union O.A.C. graduates from all parts of the Do inion.

C.S.T.A. GRADUATE SCHOLARSHIP.

A special committee was appointed to ɔnsider the qualifications of applicants for ıe C.S.T.A. Scholarships. Two scholarships ère available, one made possible by the ad-ertisers in *Scientific Agriculture*, and donat-l by the C.S.T.A., and another offered by ıe Quebec Department of Agriculture to any ember of the C.S.T.A., resident in Quebec. ach scholarship has a value of $600.00 and tenable at any recognized institution in ıy part of the world. The report of the ɔmmittee follows:—

Your Committee on Gradute Scholarships ɛgs to recommend:

(1) That Mr. W. F. Hanna, B.A. (Dal.), .Sc.A. (Alta.), M. Sc. (Alta.), be awarded ıe Scholarship donated by the Society for ost-graduate work;

(2) That in the case of the Scholarship ɔnated by the Department of Agriculture ɔr the Province of Quebec, the General Sec-ɛtary be instructed to extend the time for ɛceiving applications to the 31st day of July, 923.

H. Clark, W. P. Thompson,
ather Leopold, G. P. McRostie,
L. S. Klinck (*Chairman*).

Complete information regarding the train-ıg and experience of Mr. W. F. Hanna is iven below:—

Born in 1892 at Musquodoboit, Halifax ounty, Nova Scotia, where he received com-ıon and high school education. Graduated ɔm high school 1909. In 1910 entered alhousie University, graduating with degree B.A. in 1914.

Enlisted with Canadian Divisional Cyclists Halifax in November, 1914. Served at ɔres and Somme during 1915 and 1916. In ctober, 1916, was recommended for com-ission. Returned to England and trained an officer cadet at Emmanuel College, ambridge. Gazetted to 6th Cameron High-nders, (15th Scottish Division) as Lieu-nant, in spring of 1917, serving with that ıit during the fighting at Ypres and Arras 1917, when he was promoted to the rank of Captain. Attached to Royal Flying Corps at end of 1917. Flew with 48th squadron in France in 1918, being wounded while engaged in an aerial combat.

Married in Paris at close of war.

Returned to Canada and took up Agriculture at the University of Alberta. Graduated as B.S.A. in 1922, with First Class General Standing, and won Governor General's Gold Medal.

Carried on graduate studies and research under Dr. Robert Newton of the University of Alberta, and received degree of M.Sc. in Agriculture in 1923.

Will take graduate work in Plant Mycology and Physiology at the University of Manitoba.

It is expected that at least one more scholarship will be available to a member of the C.S.T.A. before the end of 1923. Applications received by the General Secretary before October 15th next will be referred to the Scholarship Committee on that date.

W. F. Hanna, *B.A., M.Sc.*

COMMITTEES

Few changes were made in the personnel of the standing committees on Research, Graduate Study, Agricultural and Educational Policies, and Marketing Education. The members of these committees for the coming year are as follows:

RESEARCH: J. F. Snell (chairman), J. M. Swaine, W. Sadler, W. P. Thompson, A. M. Shaw, A. T. Charron, P. A. Boving, G. P. McRostie and T. G. Bunting.

GRADUATE STUDY: R. Newton (chairman), W. H. Brittain, M. Champlin, G. G. Moe, R. D. Colquette, Gus Toupin, B. T. Dickson, E. S. Archibald.

AGRICULTURAL AND EDUCATIONAL POLICIES: L. S. Klinck (chairman), E. A. Howes, J. B. Reynolds, H. S. Arkell, M. Cumming, Father Leopold, F. C. Harrison, W. J. Rutherford, C. H. Lee, and J. B. Spencer.

MARKETING EDUCATION: A. Leitch (chairman), J. F. Booth, W. A. Brown, A. C. McCulloch, J. G. Robertson, E. F. Palmer, L. C. McOuat, F. M. Clement and R. S. Kennedy.

Other committees appointed by the Dominion Executive, are as follows:

FINANCE: Arthur Gibson (chairman), W. H. Brittain, C. M. Learmonth.

MEMBERSHIP: L. H. Newman (chairman), Gus Toupin, E. A. Howes.

AFFILIATIONS: W. H. Brittain (chairman), L. H. Newman, R. Newton.

SCHOLARSHIPS: L. S. Klinck (chairman), Father Leopold, G. P. McRostie, W. P. Thompson, G. H. Clark.

CONSTITUTON AND BY-LAWS: R. S. Kennedy, W. H. Hill.

BALLOTS: L. H. Newman, E. S. Archibald, L. C. McOuat.

EXECUTIVE COUNCIL: H. Barton, Jules Simard, L. H. Newman, Arthur Gibson, T. G. Bunting.

ASSOCIATE EDITORS: H. S. Arkell, J. B. Spencer, J. M. Swaine.

EDITORIAL BOARD: (See elsewhere in this issue).

Representative on Council of A. A. A. S.: J. E. Howitt.

ATTENDANCE

It is impossible to state just how members actually attended the Conver Some did not register and some did nc main for all the meetings. A numbe non-members were also present. The n of members who signed the official reg are as follows:—

F. H. Auld, Regina, Sask.; V. S. Asn son, Vancouver, B.C.; C. G. Anderson, ina, Sask.

H. Barton, Macdonald College, P.Q.; Bunting, Macdonald College, P.Q.; F Bates, Regina, Sask.; W. S. Benson, S toon, Sask.; R. K. Baker, Saskatoon, S E. E. Brockelbank, Saskatoon, Sask.; Blakeman, Winnipeg, Man.; E. G. B Saskatoon, Sask.; A. R. Brown, Saska Sask..

A. D. Campbell, Winnipeg, Man.; C Cutler, Edmonton, Alta.; H. A. Craig, monton, Alta.; F. M. Clement, Vancouve C.; M. Champlin, Saskatoon, Sask.; C Clark, Ottawa, Ont.; B. A. Cooke, Re Sask..

J. S. Fulton, Saskatoon, Sask.; W. H. field, Lethbridge, Alta.; F. Foulds, W peg, Man.; W. P. Fraser, Saskatoon, S M. L. Freng, Lethbridge, Alta.

K. W. Gordon, Saskatoon, Sask.; I Galbraith, Vulcan, Alta.; F. H. Grin Ottawa, Ont.; C. H. Goulden, Saska Sask.; J. W. Gibson, Victoria, B.C.

E. C. Hallman, Acadia Valley, Alta. H. Hicks, Agassiz, B.C.; W. J. Hooper, atoon, Sask.; T. J. Harrison, Winnipeg, M E. A. Howes, Edmonton, Alta.; E. S. kins, Ottawa, Ont.

L. E. Kirk, Saskatoon, Sask.; L. S. Kl Vancouver, B.C.; R. S. Kennedy, Mon P.Q.

Father Leopold, Oka, P.Q.; C. M. month, Regina, Sask.; D. E. Lothian, sion City, B.C.; A. Leitch, Guelph, W. R. Leslie, Morden, Man..

James Murray, Medicine Hat, Alta.; McKean, Saskatoon, Sask.; A. M. Mc son, Saskatoon, Sask.; J. Macgregor, S Edmonton, Alta.; G. P. McRostie, Ot Ont.; G. G. Moe, Vancouver, B.C.; W

Munro, Rosthern, Sask.; W. H. MacGregor, P.E.I.; J. E. McLarty, Denholm, Sask.

L. H. Newman, Ottawa, Ont.; R. Newton, Edmonton, Alta.; R. G. Newton, Invermere, B.C.; R. W. Neely, Regina, Sask.; J. C. Noble, Regina, Sask.

A. E. Potts, Saskatoon, Sask.; A. W. Peterson, Charlottetown, P.E.I.; A. E. Palmer, Lethbridge, Alta.; C. F. Patterson, Saskatoon, Sask.

J. G. Rayner, Saskatoon, Sask.; P. E. Reed, Regina, Sask.; W. J. Rutherford, Saskatoon, Sask.; J. H. Ross, Regina, Sask.; J. B. Reynolds, Guelph, Ont.

J. M. Smith, Regina, Sask.; W. J. Squirrell, Guelph, Ont.; W. Southworth, Winnipeg, Man.; R. Summerby, Macdonald College, P.Q.; E. C. Sackville, Swift Current, Sask; G. M. Stewart, Calgary, Alta.; P. Stewart, Ottawa, Ont.; T. Stevenson, Saskatoon, Sask.; H. Saville, Regina, Sask.; A. M. Shaw, Saskatoon, Sask.

M. N. Tompkins, Antigonish, N.S.; W. P. Thompson, Saskatoon, Sask.; C. Tice, Victoria, B.C.

J. M. Varey, Saskatoon, Sask.; S. H. Vigor, Regina, Sask.

W. E. Walker, Regina, Sask.; W. R. White, Ottawa, Ont.

Officers of the C.S.T.A., 1923-24.

H. BARTON
Macdonald College, P.Q.
President

JULES SIMARD
Quebec, P.Q.
Vice-President.

E. A. HOWES
Edmonton, Alta.
Vice-President.

L. H. NEWMAN
Ottawa, Ont.
Honorary Secretary

Presidential Address

BY J. B. REYNOLDS,

President of the Ontario Agricultural College, Guelph.

Why is the C.S.T.A.?

All professional and technical occupations have their organizations, and their purpose is explained in the benefit to the public, or to the profession, or to the individual members, resulting from such organizations.

Agriculture is the oldest of arts, and the newest of sciences, and among the latest of recognized professions. The importance of agriculture as a science and a profession is proportionate to the importance of agriculture as a source of national wealth. Hence it would seem that any collective action which may protect, and dignify, and increase the serviceableness of professional agriculture should be approved and supported by all those eligible for membership and by the public as well.

The members will be gratified to learn that according to the report of the Secretary, the past year has seen very satisfactory growth in all of the affairs of the Society. Some of the particulars of progress may be mentioned.

A satisfactory financial balance has been maintained. When we remember that the expenditure includes the Secretary's salary, the expenses of his office, and the cost of publishing the magazine, and that the only sources of revenue are the small membership fees and the advertising, we have reason to feel gratified by this item of the report.

In February under the direction of the Board the C.S.T.A. booklet was published, setting forth the objects of the association. The wide distribution of this booklet should not fail to increase the interest of the old members, and awaken interest in those who should be members of this young Society.

The quality of the Society's magazine, *Scientific Agriculture*, has been well maintained, and even improved. Between popular articles and practical information on the one hand, which are designed to interest and to aid the practical farmer, but which are thought by some to be beneath the dignity a technical journal; and highly technical ticles on the other hand, descriptive of p cesses and conclusions of little immediate terest to the dirt farmer; between these extremes the magazine has sought the mid of the road, and has been reasonably succe ful in finding it.

There has been a net increase in me bership with few resignations, and a grati ing activity among all the local branches. seems right that the central organizat should look to the local branches for ma taining interest in the Society and for creasing membership. The territory is wide to permit of more than one cent conference in the year, and this one meet in the year is not enough to keep the clai and the advantages of the Society constan in the minds of technical agriculturists. Th is a just pride belonging to membership any such organization, as well as unity purpose and fraternalism. These conside tions should outweigh all natural selfishn and indifference and absorption in perso interests, and result in a Society numerica stronger than it is at present.

The General Secretary is to be highly co mended for his untiring energy, and for very efficient management of the affairs the Society. The Secretary performs duties of correspondence with the many cal branches, besides attending local m ings and keeping the members informed pecting the progress of the Society's in ests. But he does vastly more than this. is editor of the magazine, and in this office must be kept busy and perplexed betw the problem of securing enough copy to the pages of the magazine, and that of sel ing the suitable and rejecting the unsuita among those articles that are offered. that is not all. He is advertising mana as well, and the continuance of the magaz as well as perhaps the continuance of society, has been made possible by the retary's judicious and persistent adverti

rogram. In order to leave him free for ese impotant tasks, the Secretary should e provided with regular clerical assistance the office, and that without delay.

In anything more that the President of he C. S. T. A. has to say at this time, it ould seem fitting to consider the vital and oundation questions affecting agriculture in anada at the present moment. Among our embers, the scientist is naturally interested rst in his research, the teacher in his teachng, the journalist in his news and his editorals, the administrator in his department. ut none of us should allow his special inerests to be the end and final object. These re only means to a greater end. Research nd teaching and writing and administration, o be rightly effectual, must have for their bjective the maintenance and improvement f the quality of farming and of country life. n whatever we do towards this great end we ender the highest kind of service to the naion. And it is not only material service, it s human service as well. Upon a successful griculture a large part of the national wealth epends, and upon the character of our rural tock depends our political and social stabilty.

The pioneer settlers of Canada were derived rom all classes, for in men and women of ll classes the spirit of adventure may be ound. Many, perhaps the majority of the riginal rural settlers, sprang from the workng classes, the laborers and the peasants of he old lands.

These came to escape from the poverty and he servitude of their ancient lot. Such beng their origin and such their purpose, they nd their descendants have highly resolved hat they will not again be reduced to peasanry. They have resolved that they will sit nder their own vine and fig tree, will work n their wheat fields and in their orchards, nd among their cattle, none daring to molst them or make them afraid. They have letermined to be free: free to educate their hildren and to worship God in the schools nd the churches they have built with their wn labor. They have determined to be ree also in their choice of occupation. They ave determined to keep open to themselves nd their children the avenues to service and success in callings other than farming. For they have always been assured that in no other way can they escape being finally moulded into a peasant class even in Canada, in no other way than to keep open the road of escape when conditions on the land threaten to become intolerable.

But economic conditions are inexorable. The deity that reigns over an increasingly complex civilization seems to demand human sacrifice. Towns spring up and grow into cities, and develop industries and trades and occupations highly organized and monopolized. And farming remains the only unorganized and unprotected industry. This condition arose in Ontario in the early eighties, and the Ontario farmer began to look elsewhere for the freedom which seemed to be denied him at home. Thousands of them left for the Dakotas and for Western Canada. In Western Canada apparently illimitable areas of fertile land beckoned the eastern farmer and offered to him renewed chances to live his life as his convictions dictated. The railways came to Western Canada and carried the farmers' wheat by hundreds of millions of bushels to the markets of eastern America and to Europe. Towns and cities grew, and bought his produce, stored and marketed his grain, imported and distributed the hundred purchased necessities and conveniences of a western farm home. Surely in this last great West freedom unassailable was to be found. But the Western farmer found his economic problems too, and again there arose a struggle from the competition of an unorganized class of workers against organizations, which threatened to filch from them their economic freedom. This struggle is recited in the story of the organizations of Western farmers.

Victory was in sight for the farmers and a workable understanding was reached between the farmers and those they called the Big Interests, when the war came, and ended, and left as one of its calamitous residues a revolution in economic conditions.

The Canadian farmer, western and eastern alike, had been fighting for an equitable reward for his labor, intelligence, and capital as compared with rewards for labor, intelligence and capital in other occupations. A certain basis had been secured whereby a farmer's pro-

duce possessed a supposedly fair exchange value as compared with materials he found it necessary to buy in his business or in his living. His labor, intelligence, and capital, employed to produce wheat, hay, milk, beef, or pork, had found an exchange value for these products whereby so many bushels, or tons, or pounds could be traded for the products of the labor of town industry and commerce. If we suppose that a fair exchange value had been reached before the war, then the present rate of exchange is decidedly to the disadavantage of the farmer.

We give comparisons of the rates of exchange between farm produce and machinery in 1914 and 1921 respectively. A farmer must grow hay to feed cattle to produce beef, and he must have a mower to cut the hay. In 1914, the farmer could exchange 700 pounds of beef for a mower. In 1921, the rate of exchange was 1550 pounds of beef for a mower. If he uses a hay-loader, he could exchange 3.6 tons of hay for a hay-loader in 1914. In 1921, the manufacturer demanded 8 tons of hay for the same article. If the farmer grows wheat and oats he needs a seed-drill to sow them and a binder to cut them. In 1914 he could procure a seed-drill for 166 bushels of oats, and a binder for 133 bushels of wheat. In 1921 a seed-drill cost him 416 bushels of oats, and a binder cost 200 bushels of wheat. A gang-plow in 1914 cost 744 pounds of pork; in 1921 the same plow cost 1200 pounds of pork. To grow potatoes a cultivator is required, which in 1914 cost the farmer 39 bags of potatoes and in 1921, 136 bags. To produce butter requires pasture and hay and grain and roots and ensilage, and these require fertile land. In 1914, 430 pounds of butter would buy a manure spreader. In 1921 a manure spreader cost 840 pounds of butter.

I am anxious not to appear either as an alarmist or as an agitator. The only considerations that justify these statements are, first, that they are true; and being true, they are of first rate importance, and should be known and acknowledged as important by all public-spirited persons, whether of town or country. Similar statements have been made elsewhere, about similar conditions. In Canada and the United States, agricultural and rural conditions are surprisingly sim lar. There is more identity than there contrast in our products, and in our marke ing problems. The rural people are ali in their character, their ways of living, a their methods of working, and there is ag cultural depression in both countries, d in both instances to the rapid deflation the prices of agricultural products in 192 accompanied by the continued inflation the prices of most, if not all, other commo ties and services.

In December last I had the privilege attending a conference on co-operative ma keting at Washington. Mr. Carl Willian vice-chairman of the conference, remark at the close of the final session that the co ference had been the most important gathe ing ever held in the United States in the i terests of Agriculture. Among the impr sive features of that impressive gatherin these stood out prominently:

The agricultural co-operative moveme was proclaimed, and generally accepte as a movement in the public interest, and n only in the farmers' interest.

As a consequence of this general opinio industrial, governmental and financial inte ests were represented at the conference spokesmen who are prominent figures American affairs.

These spokesmen approved and endors the co-operative movement with comple unanimity.

Agriculture, in a nation that has become largely industrial as the United States h become, was announced still to be the bas industry of that country.

And Agriculture in the United States w admitted, by farmers and financiers alike, be in desperate straits, and requiring despera remedies to restore it to its rightful place the economic welfare of the people.

And lastly, co-operative organizations f marketing purposes were seen to be the be if not the only remedy for the present ag cultural depression.

Following are a few of the observatio made by speakers at the conference,—by su men as Judge Bingham, proprietor of t Louisville Courier-Journal and chairman

conference; Herbert Hoover; Eugene
er, President of the War Finance Cor-
ation; Mr. Allen, President of the Bankers'
ociation; Senator Capper, one of the prime
ers in the Agricultural Bloc,, and Mr.
lace, Secretary for Agriculture in the
ding Administration:

The purchasing power of farm produce in
2 is 70% of that in 1913".

The nation cannot afford to pay less for
ood than it costs to produce it."

The farmer has suffered more than any
r class. He has a right to complain. He
a right to demand relief."

Unless we are going to continue breaking
speed limit toward the doom reached by
ylon and Rome through the impoverishing
griculture, something must be done."

We have come to the end of the period
xploitation when the farmer may look
his profits to the increase in the value of
land; but that profit must come, if it
es at all, from sound methods of pro-
ion and marketing."

may be said, and is often said, that if
ners are not content with their rewards
heir conditions, they are at liberty to quit
seek other occupations. But that is ex-
v what the public welfare demands that
should not do. Farmers are able at
time to extricate themselves from intol-
le or undesirable conditions by leaving
r farms, and have been doing so at a
that has alarmed the people of the towns.
the public cannot so easily extricate
f from the consequences which result
n good farmers leave the land. It is
nly not in the public interest that exper-
ed and capable farmers and farmers' sons
he Canadian type should leave their oc-
ation, and be replaced by farmers of the
opean type, or by farmers with little or
arming experience.

here is a striking passage in that strik-
French Canadian story "Maria Chapde-
" in which a daughter of the people,
ted by an opportunity to leave the hard
litions of the pioneer's life in Northern
bec for the easy and brilliant life of an
rican city, hears the voice of her native
ince pleading with her to stay with her
le:

"For in truth all that made the soul of the province spoke in that voice. The treasured solemnity of the ancient culture, the sweetness of the old language jealously maintained; the splendor and the rude vigor of the new country where an ancient race renewed its youth."

The voice said:

"We came here three hundred years ago, and we have remained. Those who have gone out from among us may return without bitterness and without sorrow, for if it is true that we have learned little, assuredly we have forgotten nothing."

"We brought from beyond the sea our prayers and our songs; they have been always the same. We have drawn a plan of a new continent from Gaspé to Montreal, from Saint Jean d'Iberville to Ungava. We have said: here all the things we have brought with us, our culture, our language, our virtues and even our failings became sacred things, intangible but lasting."

"About us the strangers have come, whom it has pleased to call us barbarians; they have taken almost all the power; they have acquired about all the wealth; but in the country of Quebec nothing has changed. Nothing will change, for we are a witness. Of ourselves and of our destiny we have understood clearly only this obligation: to stick, to hold our ground. And we have held our ground, perhaps in order that ages hence the world will turn to us and say: "This people comes of a race that cannot die".... We are a witness.

"That is why we should remain in the province where our fathers have remained, and live as they lived, to obey the unexpressed command lodged in their hearts, which has been passed on to us, and which we in our turn must transmit to our numerous offspring. In the country of Quebec nothing should die and nothing should change."

This is said of the rural people of Quebec: "Of ourselves and of our destiny we have understood clearly only this obligation: to stick; to hold our ground—and we have held our ground."

I believe that those words were written with entire sincerity and honesty of purpose, but what are the facts? The rural popula-

tion of British Columbia increased from 1911 to 1921 by 88,000; of Alberta by 129,000; of Saskatchewan by 177,500; of Manitoba 87,500; of Ontario 27,600. The rural population of Quebec decreased during that period by 304. Rural Quebec lost in the ten years all her natural increase, and more.

In rural Quebec we find a people of almost complete solidarity, of one language, one race, one faith; a people whose natural rate of increase is much greater than in the other provinces; a people ministered to by a church and a clergy with acknowledged prestige and authority; and that church and clergy, if we are not misinformed, have declared it to be the duty and the destiny of their people to stick to the land, to hold their ground, to treasure the occupancy of the soil as a sacred heritage handed down from their fathers through three hundred years.

If these people thus endowed with ancient memories that cling to the land of their native province; if these people thus counselled and thus led, have nevertheless not succeeded in holding their ground, and have abandoned the heritage of their fathers; what wonder if the more restless people of the other provinces, with a newer tradition, led by less united counsels, what wonder if they too should seek fresh fields and pastures new?

The remedy is not in a contented peasantry having no hope and no outlook beyond the confines of their own farms, even if a contented peasantry were possible on the soil of Canada, and it is not possible. The world of opportunity is too near, too accessible. And so the law of supply and demand, the law of supply of opportunity and demand of freedom, operates here as elsewhere.

Where is the remedy? Not in a return to more primitive methods of farming by a primitive peasant class, but in better farming, more direct and less wasteful ways of marketing, better opportunities for living in the country. All these matters, should be considered not primarily from the viewpoint of the farmer or the farmer's interest, but for the public welfare.

These are some of the services that need to be rendered in a public way, to insure in the public interest the best farming and to conserve the best type of farmer — ser which the farmer cannot secure for hi acting individually; to make it easier the farmer to own the land he works ownership is better for the public we than tenancy: to establish an economic of tenancy, that will enable tenants to prove the farms they occupy; to co scientific investigations for the purpo guarding agriculture against the hostili nature, in the forms of weeds, insects, eases, and the degeneracy that over species of improved plants and animal relieve the farmer from the tyranny an capriciousness of the market to such gree as other occupations are relieved enable him to compete on equal terms i bid for labor against public and other va'e enterprises; to make it possible for to educate his children without sending away from home at a tender age; to assi such community organizations as will e to him and his family a satisfactory s and intellectual experience.

Let it be repeated with all possible phasis: the argument here is, the publ more concerned even than the farmer in serving the natural resources of the p domain, in the production of food, an the character and condition of those who in the country.

The public welfare demands that the tility of the soil be maintained unimpa The history of agriculture reveals the that when farmers are left to their ow vices under the pressure of ordinary omic conditions, the farming methods a ed result in the continual diminishing of fertility. It was observed in New Eng and in parts of eastern Canada fifty ago and more, that the land was beco "run out". Even on the prairie soils o west, where the fertility was once sup to be inexhaustible, farmers in the older tions are beginning reluctantly to admit the productiveness of the soil is not wh once was. Only good farming can mai unimpaired the fertility of the soil. good farmer, therefore, is confronted w double task:—the one, is self-interest, to his living from the land; the other, i public interest, to maintain undiminishe natural resources of soil fertility. U

nditions that encourage permanent tenancy
d a proprietary interest in the land, these
interests, private and public, coincide.
nancy as it prevails in Canada, as opposed
ownership, encourages systems of farming
t exhaust the soil. The prevailing terms
tenancy are a fixed annual rent, or rental
shares, with no guarantee to the tenant that
owns a share of the value of improvements
cted at his own cost. The speculating
ner of western prairie lands, who has
ght to sell again as soon as he can turn
r the deal at a satisfying profit, will not
t his land for a long term of years. He
fers to rent from year to year. The ten-
, in such circumstances, finds it to his
erest to take as much out of the land as
can, and to put little in, either in the form
labor or of fertilizers. And even the
ners of the farms they occupy do not con-
ve the fertility or establish permanent
provements, unless they are good farmers,
d content with their occupation and with
conditions amidst which they live.

The public welfare requires that the work
the agricultural colleges and experiment
tions be continued and enlarged. The
velopment of agriculture has consisted in
selection of certain plants and animals
domestication, and the continued im-
vement of the selected species by further
ction and by breeding. Human selection
d natural selection do not follow the same
cesses, or recognize the same purposes.
cordingly, there has developed a hostility
nature against the artificial improvement
plants and animals. The physical law of
degradation of energy, or something
logous in biology, tends to counteract the
provement of species by human selection
d humanly-devised plans of breeding. The
duc's of breeding stations are placed in
hands of practical farmers, but unless
y exercise much the same knowledge and
lful care as were required in the breeding
he improved strains, degeneration is certain
rapid. The more farm products are the re-
s of human selection, the greater are the
wledge and the skill required to main-
their quality. Human selection has creat-
ll the problems of weeds and insects. The
ner is unable by himself to investigate
characteristics and the life history of his
natural enemies. Governments everywhere, in all countries in which there has arisen any public interest in agriculture, have accepted the duty of establishing experiment and research stations for investigating animal and plant diseases, for the improvement of crops and animals, and for the eradication and control of weeds and insect pests. The increased value of three principal grain crops in Ontario in the last twenty years—winter wheat, oats, and barley—brought about by the increase in yield per acre, has amounted to $134,667,000. This increase has resulted either from improved methods of farming, or from the use of improved varieties. Either way, the college and experiment stations are entitled to much of the credit for this enormous accession to the national wealth, and have therefore operated in the public welfare. In the public welfare also, governments have passed legislation for the control of noxious weeds and insects and infectious animal diseases, and have appointed administrative officers to see that such enactments are enforced. For the country cannot afford to allow the work of good farmers to be destroyed through the carelessness and the indifference of their neighbors.

The public welfare requires also that the discoveries of experiment stations be made known to all farmers as soon as possible, to the indifferent farmer as well as to the interested farmer. Hence has arisen the system of appointing agricultural representatives, as they are called in Canada, or county agents in the United States. It was found that the large expenditures of the experiment stations, and the very valuable discoveries of those stations, were not producing corresponding results in farming methods. The interested farmer had learned to write to the colleges and experiment stations for information, and to use new varieties, new systems of farming, and new methods of control, as they were recommended. But the chance to write did not appeal to the indifferent farmer. It was found necessary to proceed on the principle, not that information was to be had if a farmer was interested enough to write for it, but on the principle that every farmer must be made aware of the new knowledge whether he would or no. The agricultural representatives have gone out in the highways and byways and compelled them to come in.

The public welfare requires that as many prospective farmers as possible shall receive definite and detailed instruction in the principles of scientific agriculture, marketing, economics, and citizenship. It is the business of agricultural schools and colleges to teach resident students the principles by which domestic plants and animals have been improved, so that in their farm practice they may maintain a high quality of product; to teach the principles of soil fertility, and along with these the obligations of citizenship, so that they may conserve the integrity of the public domain; to teach the disastrous results that flow from careless methods in handling orchards and field crops and live stock, and along with that teaching to teach methods of control, so that they may not destroy potential wealth, or allow their farms to be a public menace by harboring noxious weeds, insects, and diseases; to call attention to the needs of rural society, and to teach the principles of rural social betterment, so that young farmers may be efficient leaders in the communities in which they live; and to teach the principles and methods of marketing, credit, and co-operation, in order that they may be able to insure themselves a fair return for their expenditure of m labor, and intelligence.

Here in the middle of the Canadian W at a time of year when the prospects o crop become more and more assured, it s fitting to offer words of congratulatio the western farmers on the reasonable surance of an abundant crop. How m they have endured, how often they wearied over hope deferred, only thems can know fully. We know this, how that season after season many have forth weeping, bearing precious seed to upon the soil. We at least have been ab appreciate the enduring patience and i able optimism of the Canadian farmers, in spite of many discouragements obeyed the Divine command: "In the m ing sow thy seed, and in the evening with not thy hand: for thou knowest not wh shall prosper, either this or that, or whe they both shall be alike good." At this tical time of the year, and at this critical in our national development, the eyes o in town and country are upon the fields

The hopes and the good wishes of all low the farmer, that he may come again rejoicing, bringing his sheaves with him

Report of the General Secretary-Treasurer.

Presented at the Third Annual Convention by Fred H. Grindley

The following report, covering the operations of the Society during the past twelve months, has been prepared with the object of drawing attention to progress made and of emphasizing certain features of its activities which should be given special consideration at this Convention. It is particularly gratifying at the close of the year to present a report which indicates steady progress, financial stability, growth in membership and increasing membership interest.

Transfer of Headquarters to Ottawa.

On August 1st, 1922, the headquarters of the Society were transferred from Gardenvale, P.Q., to Ottawa. This change was made partly because Ottawa was considered by the Dominion Executive Committee to be a more desirable headquarters and partly cause better arrangements for printing magazine could be made at Ottawa. change has proven to be very desirable

Membership

During the year it has been necessar remove the names of 43 members, either cause of written resignations or for payment of annual fees. This compares ourably with the 75 resignations rece during the previous year.

There have been 122 applications for m bership, including 10 for associate mem ship, as compared with 102 applications previous year.

The present membership of the Socie therefore increased from 583 members

ported on June 1st, 1922, to 662 members on June 1st, 1923. The names and addresses of all members by branches are embodied in the Convention programme and their distribution is as follows:—

	June, 1923	June, 1922
Alberta	59	35
British Columbia	63	71
Manitoba	52	48
New Brunswick	27	30
Nova Scotia	23	21
E. Ontario	95	80
W. Ontario	96	68
Prince Ed. Island	12	12
Macdonald	56	49
Montreal	42	42
Quebec	50	56
North Saskatchewan	28	20
South Saskatchewan	38	32
U. S. and Foreign	21	19
Total Membership	662	583

The increase in membership is particularly noticeable in the Alberta and Western Ontario branches.

Text Book Club

At the time of the last Convention a Text Book Club had been in existence for a period of two months and it was reported that little interest was being taken by the members in this branch of the Society. Since that time however, the Text Book Club has become more generally known among the members with the result that during the past year orders for Text Books amounting to approximately $500.00 have been received from members of the Society to whom these books have been delivered postpaid at a discount of twenty percent below list prices. There is every reason to believe that the Text Book Club will steadily increase in usefulness as it becomes better known and appreciated by the membership body.

In this connection reference should be made to the contact which has been established between the office of the Society and a number of publishing houses. Partly on account of the Text Book Club and partly by reason of a number of exchanges which have been developed between the official organ of the Society and many similar publications throughout the world, the possibility of establishing a current index to periodical agricultural literature has suggested itself. In view of the fact however, that much of such literature is already being received at the library of the International Institute of Agriculture at Ottawa, a current index of very great value might be compiled through a co-operative arrangement between the C.S.T.A. and the International Institute. During the past year the possibility of making such an arrangement has been suggested, but no definite action has yet been taken.

Bureau of Records

The Bureau of Records which was established in the office of the General Secretary in March, 1922, has not been active and has not served either the members of the Society or institutions seeking technical men, to the extent that was anticipated. The fact that agricultural institutions are seeking specialists and that comparatively few members of the C.S.T.A. have had specialist training, is an obstacle to the success of the Bureau which was pointed out one year ago. In March, 1923, an effort was made to secure from members of the Society who had not previously furnished it, the information which was required for the Bureau, and between that time and May 31st, a fairly satisfactory response was obtained in this way.

There is no doubt that the information now recorded in the office of the General Secretary constitutes a very valuable reference, but it appears to be doubtful whether this information is likely to be sought by those to whom it would be of the greatest service. If the Bureau of Records is to be developed into a useful part of the Society's operations, it would seem that the best form such development might take would be that of a printed list of the members of the Society together with such details regarding professional experience, academic training, etc., as might be necessary. Such printed information should not refer in any way to salaries, but should be given general distribution among all institutions which might be expected to use it for reference purposes.

It must be understood that a Bureau of Records, if it is to be active, requires almost

the constant attention of one individual and as there is little indication that a Bureau of this kind for technical agriculturists can function to good advantage, the alternative suggested might be adopted without entailing a great deal of work and at the same time would probably perform a service to professional agriculturists in Canada that would be generally appreciated and would reflect credit upon the Society.

Scientific Agriculture

The fact that the publication of *Scientific Agriculture* constitutes the major feature of the Society's activities is generally recognized. What is perhaps not fully appreciated is the extent to which the existence of the Society is dependent upon its official organ. An effort has been made, in preparing the financial statement for the year, to illustrate the fact that the revenue derived from the advertising in *Scientific Agriculture* is considerably larger than the revenue derived from membership fees. There have been many periods during the past twelve months when the magazine was bearing the entire financial burden of the Society and too much credit cannot be given to the advertisers in *Scientific Agriculture* for their assistance in maintaining this publication upon such a satisfactory basis.

Under our present advertising policy the influence of the membership body upon rural communities in Canada is the sole argument being used to secure advertisements. Advertising space in *Scientific Agriculture* cannot be sold on a basis of circulation and must be sold on a basis of service for service. Unless this fact is thoroughly appreciated by every member and unless our advertisers know that it is appreciated, the present financial revenue from this source cannot possibly be maintained.

A number of improvements have been made in the magazine during the past year and these have been recognized and commented upon by many members:—

A better quality of paper and greater efficiency in printing have been quite apparent.

It has been possible to submit proofs to authors prior to publication, in a great many instances, and one hundred reprints have also been furnished when requeste without any charge to the author.

The use of envelopes instead of wrappe for magazines going to the members is al an important improvement made during th past year.

The arrangement of the reading matter s that it can be separated fro n advertisin matter and bound in volumes in a satisfa tory manner has also been accomplished th year.

An effort has been made to publish or or two special numbers for local branch of the Society and it is possible that th publication of special numbers at regul intervals might be desirable.

No changes have been made in the ed torial or advertising policies of the magazi but frank expressions of opinion regardi these policies are desired and ought to b given by members of the Society on freque occasions.

Travelling

It has been possible for the General Se retary to travel more extensively during th past year than during the year previous. I connection with the work of the magazine a travelling has been confined to the provinc of Ontario and Quebec but in order to a tend meetings of the local branches an e tended trip was made to the West in Nove ber, 1922 and a brief visit to the Maritim provinces in December. On the Maritim trip a joint meeting of the three easter branches of the Society was attended o December 13th at Amherst and on the We tern trip the branches of Manitoba, Nort Saskatchewan, South Saskatchewan and A berta were visited. The branch in weste Ontario was visited at its annual meeting o April 27th, 1923 and the branches of easte Ontario, Macdonald College, Montreal an Quebec were visited on at least one occasio during the year. It has thus been possibl for the General Secretary to come into pe sonal contact with the members of eve branch of the organization with the exceptio of British Columbia and only pressure o time prevented the extension of the weste trip to the Pacific coast.

In spite of a great increase in the amou of travelling done by the General Secretar

is interesting to note that travelling expens for the year are slightly lower than for 921-22 and in this connection special credit ust be given to the Canadian Pacific Railay Company which has furnished free ansportation to the General Secretary roughout the year for practically all jourys sufficiently extensive to warrant a reiest for same.

Graduate Scholarships

In January, 1923 the possibility of establshing C.S.T.A. scholarships for the encourgement of specialist training by members of e Society, suggested itself and considerable me was spent in organizing the details ecessary for the establishment of such holarships. A Board of Trustees was apointed with representatives in the different ctions of Canada and the members of this oard accepted the responsibility of raising oney for the general fund. So far as the eneral Secretary was concerned, his efforts ere confined to increasing the advertising evenue of the magazine sufficiently to perit the establishment of one scholarship onated by the advertisers. The arguments resented apparently appealed to a number f manufacturers and the scholarship secured this way will be awarded at this Conveniion. The Quebec Department of Agriculire has also agreed to give one scholarship f $600.00 to a member of the Society resient in Quebec.

Up to the present time these two scholarhips represent the work of the past three nonths and while better results might have een anticipated, the establishment of two cholarships in so short a time should be onsidered as highly gratifying. It is generlly considered that if proper publicity is iven to the fact that a fund has been estabished by the C.S.T.A. for such a creditable urpose, generous financial assistance might e expected from several sources and the umber of C.S.T.A. scholarships should increase as time goes on.

C.S.T.A. Booklet

In February, 1923 the General Secretary repared a complete history of the organizaion and development of the Society and vith the authority of the Dominion Executive Committee prepared a special booklet which included not only the history of the organization but also a list of members, the personnel of committees and much other information of special interest. This booklet was sent to every member of the Society, and was used in connection with a Dominion wide membership campaign. The results obtained can hardly be estimated but it is quite likely that the booklet served the purpose for which it was intended and it certainly did result in a considerable increase in membership during the months of March and April.

It might be desirable to consider the publication of a similar booklet, on a somewhat more modest scale, annually.

Local Branch Activities

All the local branches have held meetings during the year and there appears to be a steady growth in interest and an improvement in the quality of programmes arranged at such meetings. Reports from these various branches will be received at this Convention and will indicate in greater detail the operations of the branches as distinct from those of the parent organization.

Standing Committees

Since the reports of all standing committees are also being presented at this Convention, little reference need be made to their activities in this report. It should be mentioned however, that the work of all standing committees is of an extremely important character and constitutes a feature of the Society's general programme to which greater credit and appreciation should be given.

Financial Situation

Some reference has already been made to certain features of the financial report which is being distributed at this Convention.*

There has been an increase in expendiures during the past year, particularly noticeable in printing charges. This is accounted for in part by the cost of publishing the C.S.T.A. booklet but is also due to the fact that the activities of the Society have extended considerably during the year and increased ex-

*Any member who wishes to obtain a copy of the Annual Financial Statement for the year ending May 31, 1923, should apply to the General Secretary.

penditures were unavoidable for job printing. The substantial increase in revenue may be attributed largely to the money spent in propaganda work of this nature.

The delay in payments of membership renewal fees caused frequent discouragement and at times threw the entire financial burden upon the magazine. It appears to be impossible to collect membership fees promptly and this difficulty is one which perhaps cannot be avoided. Members should however, appreciate the fact that the organization depends very largely for its financial stability upon the prompt payment of all dues, and this condition is more serious since the fee was reduced last year from $10.00 to $6.00.

The magazine is bearing too much of the financial responsibility and as a natural consequence the General Secretary is spending too much time upon duties of a strictly commercial character. It is quite apparent from the financial statement that the magazine, and not the membership fees, is the principal source of revenue. There is no certainty that the advertising revenue which has been maintained during the past twelve months can be maintained indefinitely. It *is* certain that the membership fees cannot be increased. The only conclusion to be drawn is that unless just as much time is spent on commercial work, and just as much revenue is derived from commercial sources, the Society is in danger of facing a serious financial situation.

After existing for three years upon its own resources, having made progress that must be considered highly satisfactory, having accomplished results that are creditable and having demonstrated beyond question of doubt the need for its existence, it appears only reasonable that some financial assistance should be available to insure continuance on a sound basis.

The need for suitable office accommodation and clerical assistance is extremely pressing and must be given consideration by the incoming Dominion Executive Committee. Ever since the organizing Convention in 1920, and increasing with each succeeding year, the routine work at the central office has developed. This work has now become diversified in its nature so that it is quite impossible to give adequate attention to a single branch. Recognition must be given the fact that an organization with 700 members, with 13 local branches, with seve standing committees, with a Bureau of cords, Text Book Club, a Scholarship Fu and in addition, an Official Organ which m be edited and maintained on a self supp ing basis, cannot be operated in other th a slip-shod fashion under the present arran ment. Unless the General Secretary is lieved of much of the routine work involv and proper office accommodation and cleri assistance is provided, a complete change the operating policies of the organizat will be unavoidable.

The suggestion has been made that the uation outlined above would be relieved the principle of paying salaries was abolish and the official organ conducted without vertising matter. Such an alternative is p haps worthy of serious consideration. all events, the financial future of the Soci is an extremely important issue and the o two solutions to the existing conditions either the increasing of overhead expense, providing office equipment and clerical sistance, or the operating of the organizat on a basis of voluntary service.

Manufacturers' News

In an effort to maintain the interest of advertisers, to give them greater service return for their assistance to the Society, monthly publication of a supplement to magazine was contemplated in May, 19 This supplement, to be known as *Manuf turers' News*, would be composed entirely contributions sent in by advertisers and de ing with any matters of interest concern their particular business. Its columns wou be given free to the contributor and distri tion would be made only to members of Society. Beyond a preliminary announ ment to this effect no further steps have b taken as yet.

The idea of publishing such a supplem for the advertisers in *Scientific Agricult* apparently meets with their full approval a might be expected to result in a sufficient crease in advertising revenue to pay for its

General.

Meetings of the Dominion Executive Committee were held at Macdonald College on June 28th, 1922 and at the University of Saskatchewan on June 20th, 1923.

The plans for the Third Annual Convention were started in March, 1923 and have culminated in the meetings which you are now attending.

Particular credit should be given to the Dominion Department of Agriculture for financial assistance in connection with the series of advanced lectures, to the Saskatchewan Department of Agriculture for providing an adequate entertainment fund and for printing the Convention Programmes, to the local committees responsible for programme, entertainment, publicity, and reception, and to many others who have contributed to the success of this Convention.

Election ballots were mailed to all members on April 10th and were opened at Ottawa on April 30th. The result of the elections as announced to the Associated Press on May 1st, 1923 and published in the June issue of *Scientific Agriculture*, are as follows:

President—H. Barton.

Vice Pres.—E. A. Howes and Jules Simard.

Hon. Secty.—L. H. Newman.

In accordance with an amendment to the by-laws at the last Annual Convention, the Dominion Executive committee for 1923-24 has, in addition to the four named officers, one representative from each local branch. These representatives have been elected as follows:—

Representing Alberta—E. Ward Jones.
" British Columbia—R. L. Ramsay.
" Manitoba—A. D. Campbell.
" New Brunswick—J. H. King.
" Nova Scotia—W. H. Brittain.
Representing Eastern Ontario, Arthur Gibson.
" Western Ontario—E. F. Palmer.
" Prince Edward Island—(to be appointed)
" Montreal—Gus. Toupin.
" Macdonald—T. G. Bunting.
" Quebec—A. Désilets.
" N. Saskatchewan—M. Champlin.
" S. Saskatchewan—C. M. Learmonth.

The Society was represented at the Annual meeting of the American Society for the Advancement of Science, of which the C.S.T.A. is an affiliated Society, by Dr. W. H. Brittain of Truro, N.S.

The General Secretary wishes to express his personal appreciation for the splendid voluntary assistance rendered by the members of the Editorial Board, the Dominion Executive Committee, the various standing committees and particularly to the secretaries of the various local branches of the Society, as well as to many individual members, for helpful suggestions and criticisms received during the year.

In conclusion, I should like to emphasize this year as I have in my last two Annual Reports, that a greater solidarity of membership interest must be developed within the organization. In all its activities, whether they be commercial or otherwise, the individual member must expect to play a part. The C.S.T.A. is a professional body and as such is entitled to the full support of all those eligible to join its ranks. Unless that support is given and maintained, proper development cannot be made. The desire for personal benefit from membership must be abolished and in its place a professional spirit of pride developed to an extent which will overcome obstacles, remove discouragement and insure safe, sane and steady progress.

Report of the Committee on Research, 1922-23.

BY DR. J. F. SNELL (Chairman)

Macdonald College, P.Q.

The personnel of this committee for the current year is: Dr. J. M. Swaine, Ottawa; Dr. W. P. Thompson, Saskatoon; Prof. R. Harcourt, Guelph; Dr. A. T. Charron, Ste. Hyacinthe; Profs. P. Boving and W. Sadler, Vancouver; Prof. J. P. Sackville, Edmonton, acting in place of Prof. A. A. Dowell, who was appointed at the 1922 Convention, but resigned on account of removal from Canada, and Dr. J. F. Snell, Macdonald College, Chairman.

In the two previous years of its existence the Committee on Research has prepared lists of suggested subjects for investigation. This year it has endeavored to gather information as to researches in progress in Canada.

To this end the following questionnaire was distributed to those whom members of the committee knew to be in charge of agricultural research work:

1. Which of the problems listed in the Report of the C.S.T.A. Committee on Research published in *Scientific Agriculture*, Sept. 1922 (pp. 3-17) are under investigation in your department?

2. In case any problem under investigation does not fully coincide with that stated in the report, indicate the scope of your investigation.

3. What problems not listed in the report are under investigation in your department?

4. Give names of persons engaged in each investigation.

5. State whether collaboration is desired, and if so in what direction.

The work of securing answers to the questionnaire was divided amongst the membership of the committee, Dr. Swaine undertaking the Dominion Department of Agriculture and the other members the territories nearest to them, Dr. Thompson for example taking Saskatchewan and Manitoba, Professor Harcourt Ontario and so on. The response to the questionnaire has naturally been uneven, and it is obvious that the tabulated results do not embrace nearly all the agricultural research in progress in Canada. It is especially realized that nearly all of the research activities of the Dominion Experimental Farms System and the other investigative branches of the Dominion Department have been reported to the Committee. Indeed those problems reported as in progress in the Experimental Farms System have been taken from lists transmitted from Divisional officials to the Director for the information of your 1922 Committee. Not all the Divisions reported at that time, and some of them appear to have been designed as answers to the 1922 Committee's request for suggestions of research topics rather than to its query as to researches then in progress. No doubt more complete information upon the research activities of the Dominion Department of Agriculture is available. In the Colleges, some departments have failed to respond, in many cases doubtless from oversight or lack of interest, in a few cases on account of personal disapproval of the principle of publishing topics of researches in progress which may not reach completion or which may develop along other lines than those anticipated.

In spite of these objections, oppositions and apathies, the Committee feels that its work has substantial value. The clear definition of a research problem is usually the first step in its solution and we believe that in asking for a statement of problems, either suggested, projected, or in progress, we are contributing to the clarification of ideas and stimulating those in charge of fields of agricultural work to a more systematic and effective cultivation of those fields. Doubtless every Government or College official in charge of a herd or flock of purebred stock has breeding records, a systematic study of which would yield results of interest in relation to Genetics. Yet if no clear project of study is conceived those records may remain neglected or superficially interpreted. In-

deed in the absence of a clearly defined aim items of importance may be omitted from the record and efforts may be wasted in the recording of unimportant information. The same may apply to the records and plans of work in agronomy and horticulture or in the other sciences. Thus in asking for a clearly defined statement we feel that we are rendering a fundamental service. Furthermore one problem often suggests another. So the publication of a list of researches serves as a stimulus to further research.

A second service which the Committee hopes to render—and the one which we believe it was primarily intended to render—is to further the co-ordination of agricultural research in Canada in such a way as to increase its effectiveness. We believe that the publication of a list of researches in progress with the names of persons either engaged in or having supervision over them—in effect persons to whom requests for further information may be addressed — will contribute to that end. And just here it may be well to state that it has not been possible to include in the tables exact and definite information as to what individuals are directly engaged in all the researches. For the Committee to assign credit to individuals we consider neither practicable nor desirable. Our aim is merely to enable investigators in similar or allied fields to find one another, and for their purpose we consider it adequate to give the name of some person or persons from or through whom authentic information may be obtained.

Some instances of existing collaboration which have come to the attention of the Committee deserve notice. A committee composed of Mr. Macoun, Dominion Horticulturist, Pres. Reynolds and Prof. McLennan of the Ontario Agricultural College and Mr. Palmer of the Vineland Experimental Fruit Station and Messrs. Stevenson and Hodgetts of the Ontario Department of Agriculture is endeavoring to co-ordinate the experimental work in Horticulture in the Province of Ontario. In British Columbia, Prof. Boving reports that the scheme of co-operation between Federal, Provincial and University men in Agronomy inaugerated four years ago and previously described to the Society by him, is still in successful operation. These workers meet annually to discuss the year's results and to agree upon plans for co-operative experimentation for the ensuing year. In the realm of Plant Pathology a scheme of international co-operation amongst Canadian and American workers in reference to the control of cereal smuts by the use of copper carbonate dust has recently been inaugerated by a committee of the Crop Institute at the suggestion of the American Phytopathological Association. In 1922 fifteen workers collaborated in this investigation, of whom five were Canadians. This year eighteen American and five Canadian plant pathologists are continuing the investigation of this method of treatment. These Canadian workers are—Mr. Güssow of the Dominion Experimental Farms System and Professors Dickson, Fraser and Jackson of the agricultural colleges.

Co-operative movements of the nature of those cited appear to us to be altogether desirable and further developments in this direction worthy of all encouragement. Two directions of development suggested themselves. One is a general extension of the system of co-operation in each Province of the Dominion—the system already in operation in Horticulture in Ontario and in Agronomy in British Columbia.

The other plan that suggests itself is the appointment by this Society of sub-committees of the Committee on Research, a sub-committee in each of the fields of work, to suggest and advise upon lines of investigation in those fields of work on the parts of investigators in the various institutions and Provinces. The National Research Council of the United States has some sub-committees of this nature, and a recently published report on Animal Nutrition* is suggestive. This committee, composed of five prominent workers, has outlined seven problems and fields of research in animal nutrition, making suggestions in regard to each and offering co-operation to anyone desiring it in the preparation of detailed plans for investigations of these problems and in these fields.

Whether this Society should have a committee of this nature is a question worthy of consideration, but one upon which your

*Science, 57, 567 (May 18th, 1923)

Committee is not prepared to take a definite stand this year. A formidable practical difficulty presents itself in the delimitation of fields of work, a difficulty which also appears in making such a classification of research problems as this year's report presents. Differences of opinion exist as to what problems belong to a certain province of science and what to another. It appears to be especially difficult to decide what projects should be assigned to the departments of science proper, such as physics, chemistry, and biology and what to the departments of the agricultural arts, such as agronomy, animal husbandry, poultry husbandry and horticulture. It is obvious that most of the problems of the latter class of departments involve research in the sciences, and the question of boundaries is a difficult and delicate one. The very plan of organization of an agricultural college or of a research institution, such as the Dominion Experimental Farms System depends on the views on these questions adopted by those responsible for the organization and a certain amount of contention and jealousy between departments is no doubt inevitable.

Some examples of the disputed claims that arise may be cited. The first project in our Agronomy list is the determination of the duration of life in buried weed seeds and its relation to soil characteristics, moisture conditions and systems of crop cultivation and rotation. Is this a problem in agronomy or in botany, or does it belong partly to the one department and partly to another? It is obvious that its investigation must be undertaken by one with a good knowledge of botany and of soils and particularly, as regards the last item, by one with a knowledge of systems of crop cultivation and rotation. A good agronomist has the necessary qualifications, but a good agricultural botanist is also competent to carry on such an investigation. How should it be classified and by whom should it be undertaken? Again, we find such projects as the investigation of the causes of frost resistance, drought resistance and disease resistance in plants. Are these properly agronomy problems or problems of plant physiology and plant pathology? We have referred to the problem of smut control as one in which plant pathologists in Canada are co-operating with plant pathologists in the United States. Yet we find that same problem listed under Agronomy and our agronomists maintain that it is one to which they must devote attention and upon which they are unwilling to abandon the right to conduct investigations. Botany and horticulture are quite as apt to come into conflict as botany and agronomy and in respect to insect control we have similar questions between entomology and the departments of agronomy and horticulture. Goitre is listed as an animal nutrition problem, but it is not distinctly a veterinary question and is it not also, in common with other nutrition problems, to a considerable extent a question of chemistry? Yet the man engaged in animal husbandry work encounters the problem, holds the responsibility for the animals affected and suffers if the problem remains neglected. Should he be debarred from investigating it?

Your committee has been obliged to carry on its work by the slow and diffusive method of correspondence. It has not been able to discuss matters together and is therefore not in a position to offer suggestions for the solution of these difficulties, much less to attempt to adjudicate between the claims of rival departments. In several instances experiments of double classification and cross reference have been resorted to, the issue being thus evaded. If we are to have sub-committees for certain fields of research it will become necessary to define the fields. It is for the Society to decide whether the Research Committee should attempt this or not.

Your Committee would urge upon the Society and through it upon the Canadian public the national importance of agricultural research and the economic value of additional expenditure in that direction. In this prairie city it may be appropriate to refer to the work of the Dominion Experimental Farms System in the development of varieties of wheat suitable for prairie conditions. It is well recognized that the wealth produced by the adoption of these products of research has amounted to hundreds if not to thousands of times the cost of the experimentation through which these varieties were produced and tested. Similar work on fruits has long been in progress at the Experimental Farms

d it cannot be doubted that the returns om this source will eventually so far ex- éd the expenditure as to prove this expendi- re an investment of profit comparable with at upon wheat.

The annual saving due to the measures vised by our investigators in the control insects and plant diseases far exceeds the st of their investigations and could be eatly increased by affording them better cilities for the prosecution of their la- rs.

We believe that all stockmen will agree at a crying need of the country is for addi- tional research, as well as additional instruc- tion in veterinary medicine. There can be no question that there is an enormous loss of national wealth caused by preventable and curable diseases and that the economies that could be realized by increasing the per- sonnel of the veterinary profession, raising the standards of instruction and especially rendering possible the adequate training in research of the staffs of the colleges and pro- viding the facilities for research in the Col- leges, as well as in the Federal Department of Agriculture, would yield a handsome re- turn upon the investment involved.

Report of the Committee on Graduate Studies.

BY R. NEWTON, (Chairman)

University of Alberta, Edmonton.

The work of the Committee on Graduate udies, for the year 1922-23, has consisted imarily of an inquiry into the opportuni- s for advanced courses and degrees open agricultural graduates in Canada. The gent need for higher training on the part our agricultural teachers and investigators d been fully set out by our predecessors in ice. Agriculture in Canada is beset with ny difficulties and problems which can be ectively attacked only by highly trained ecialists. The first responsibility to meet s situation falls upon our educational in- tutions.

Hitherto we have relied to a considerable ent upon our neighbours to the south for solution of problems requiring intensive ndamental research. It is high time, how- r, that Canada attained her maturity in tters scientific. That is not to say, of urse, that a large measure of interchange students with other countries is not mutual- profitable. Quite the reverse is true, and s to be hoped that a large number of our duate students will always take advantage special opportunities in the laboratories of ropean and American universities, and ng back to us an enlarged outlook as well a broader training. But the matter of going abroad for graduate study in agricul- ture should not be one of compulsion; the movement of our students should be one of interchange, not exportation.

Some of our colleges have made a begin- ning in graduate instruction, and the Com- mittee felt that the most useful service it could perform was to collect information as to the present status of the work. It should then be possible to go forward with plans and recommendations for future develop- ment. A summary follows of the informa- tion obtained with regard to organization, courses, and general requirements, in in- stitutions offering advanced degrees in agri- culture.

Alberta:

1. Graduate work at the University of Alberta is under the direction of a commit- tee on graduate studies.

2. In agriculture, only one advanced de- gree is offered, namely, M.Sc. For this de- gree, one academic year of full-time work is required, but it may be spread over two or more years of part-time work.

3. Advanced courses in farm crops, gene- tics and plant breeding, and plant biochemis- try are offered in the Faculty of Agriculture,

and related subjects, such as botany and chemistry, may be taken in other faculties of the University. Additional courses in the Faculty of Agriculture will be developed as the demand for them arises. Courses are not divided into majors and minors, but are selected in consultation with the student's adviser.

4. Students are expected to devote approximately half their time to research on a thesis project.

5. A reading knowledge of French or German is advised, though not definitely required.

6. Written examinations are given on all course work. In addition a final oral examination is required.

7. The degree of D.Sc., for special distinction in scientific resarch, is open to members of the Faculty of Agriculture on the same basis as to members of other scientific departments. This degree cannot be attained, however, by taking courses or covering any prescribed amount of work. A Bachelor of seven years standing may become a candidate if the number and quality of his research papers warrant it.

British Columbia:

1. Graduate work at the University of British Columbia is controlled by the deans and department heads most concerned. The courses are outlined by the department head in conference with the student, and approved by the dean of the Faculty.

2. The Master's degree only is offered. This requires one year of resident study, or two years of extra-mural study, or a half year resident study and one year extra-mural study.

3. About two-thirds of the time is devoted to the major subject, and one-third to the minor. No specific courses are outlined in the calendar, but students are given special and particular outlines by the major adviser. Work may be taken in any department of the Faculty of Agriculture, with minor in economics, botany or any other science subject.

4. The thesis is the most important factor on which the student is judged.

5. There are no foreign language quirements for the Master's degree.

6. All students are given written e inations on both major and minor subj An oral examination is also required. partment heads do their own examinin

McGill University and Macdonal College:

1. Graduate work at McGill Unive and Macdonald College is under the co of the Graduate Faculty of McGill Univer All professors giving graduate work members or associates of the Graduate F ty, but representative members are chose groups of subjects, to constitute somethi the nature of executive committees.

2. The following graduate degrees offered:—

M.S.A. in agronomy and poultry.

M.Sc. in bacteriology, biochemistry, any, chemistry, entomology, physics, p pathology and zoology.

Ph.D. in bacteriology, biochemistry, any, chemistry, entomology, plant patho and physics.

Minimum full-time requirements for M. and M.Sc. are one college year or two te for Ph.D., three college years or 6 terms

3. Courses are divided into majors minors. Minors are offered in all the a departments. The minor courses must exceed 25% of the total units for the deg

4. No definite division of time is arr ed between thesis and course work, but provided that for M.Sc. and first yea Ph.D., candidates shall complete six u other than thesis work, for the second of Ph.D. four units, and for the third three units. Of these units 50% shall *bona fide courses*. For the purpose of termining units the following definitions established:

1 hour lecture	—	1 u
2 hours laboratory	—	1 u
1 hour seminar.	—	2 u
1 hour colloquium	—	2 u
1 hour tutorial	—	2 u
1 hour supervised reading	—	2 u

5. No foreign language requirements laid down for M.S.A. and M.Sc. For P

reading knowledge of French and German required, prior to the termination of the d year.

6. For M.A. and M.Sc., written examations are required in addition to the thesis. or Ph.D. there are written examinations in ch of the courses, a final general written amination on the major subject, and a ublic oral examination in both major and inor work (and on the thesis if desired.)

Manitoba: —No graduate work as yet.

Ontario: —No graduate work as yet.

Saskatchewan:

1. Graduate work at the University of skatchewan is controlled by a committee the University Council.

2. The Master's degree only is offered. is requires at least one academic year in sidence (one calendar year in the case of e M.S.A.), or at least two academic years those cases in which the nature of the subcts permit the work to be done extraurally.

3. Major courses are offered in soils, eld husbandry, animal husbandry (includg poultry and dairying), and agricultural gineering. Minors are offered in biology, emistry, physics and economics.

4. At the option of the departments conrned, examinations may be conducted by al or written tests, or by means of a thesis a subject approved in advance, or by both esis and examination. The passing standd in examinations shall be as high as that r honors in a special undergraduate course.

NANCIAL ASSISTANCE AVAILABLE TO GRADUATE STUDENTS.

A second part of the enquiry carried out the Committee had to do with financial sistance available to graduate students in riculture, in the form of scholarships, felwship and part-time assistantships. It was und that, except in the case of one institun, assistance of this nature is so far rathlimited, although all persons approached em hopeful of early developments along is line. A detailed statement follows:—

Alberta:

No scholarships or fellowships are available. Two graduate students are employed in the University Department of Field Husbandry, one as part-time assistant in genetics and plant breeding, and one as part-time assistant in plant biochemistry. These students each receive $1000. for eleven months service, and obtain M.Sc. in two years.

British Columbia:

No scholarships or fellowships. One assistant in the University Department of Horticulture receives $78 per month for ten months, devoting half his time to department duties and half to graduate work.

Macdonald College:

W. C. Macdonald Regd. have established ten scholarships, valued at $500. each, allocated to students in the different provinces, and tenable at Macdonald College.

The Provincial Government of Quebec has established three scholarships for Quebec students, tenable at Macdonald College.

The Milton Hersey Scholarship of $400. for graduate work in agricultural chemistry, is open to any Canadian student, and tenable at Macdonald College.

The Macdonald College Alumni Scholarship of $250. open to graduates of Macdonald College.

Manitoba:

No assistance for graduate work is offered at present at the Manitoba Agricultural College.

The Hudson's Bay Scholarship, offered annually and valued at $1500, is open to graduates in any branch of science (including agriculture), from any Canadian institution, and tenable at the University of Manitoba.

Ontario:

No assistance for graduate work offered at present.

Saskatchewan:

No scholarships, fellowships, or part-time assistantships in agriculture at the University of Saskatchewan. An annual

scholarship of $800 has been provided to enable a promising student each year to study abroad for at least two years, depending upon the progress made.

C.S.T.A. Scholarships

The Canadian Society of Technical Agriculturists has established a number of scholarships of a value of $500 or $600 each, open to members of this society and tenable at any approved university in any country.

Research Council

The studentships, fellowships, and bursaries administered by the Honorary Advisory Council for Scientific and Industrial Research are open to agricultural graduates, and tenable at any university in Canada.

QUESTIONS OF POLICY

In addition to conducting the inquiry just reported, the Committee discussed by correspondence various questions of policy in the development of graduate work in this country, upon which it was thought that a carefully considered, joint expression of opinion might prove helpful to those in whose hands rest the administrative responsibilities.

Centralization of Graduate Work

The first of such questions to be raised by a member of the Committee related to the possible centralization of graduate work at one institution, as against the encouragement of its development at a number of colleges. The fact is recognized that a number of institutions are already committed to graduate work, at least as far as the Master's degree, and the Committee members were in general agreement in the view that any college which may wish to give graduate instruction should not be discouraged from doing so. However, when it came to the question of doctorate work, in support of which special governmental grants might be sought, some of the eastern representatives were in favor of centralization, while all the western representatives dissented from this view. It was pointed out that if the graduate school was established east of the Lakes, it would be impossible for the institution to give advanced work in subjects of a regional nature, such as irrigation and soil problems peculiar to the Prairie Provinces or to British Columbia. Accordingly, a strong case was made for at least one institution of the Lakes giving doctorate degree agricultural science.

Several advantages and disadvantages pear to be inherent in both plans, an the absence of an agreed opinion, the that can be done is to present the gist o arguments advanced on both sides.

In favour of concentration at on stitution:

1. The number of highly trained spe ists likely to be needed in Canada in the few years is too small to justify the estab ment of more than one fully staffed equipped graduate school.

2. The establishment of a numbe schools would create needless compet with well equipped institutions easily a sible in the United States, especially i more purely "science" subjects, in w regional considerations do not come in tion.

3. Centralization would make for a degree of efficiency as well as economy pecially if the agricultural college sel were in direct contact with the rest of university.

4. A large graduate school provides portunity for contact with many other uate students and a considerable numbe highly trained instructors, with all the b ening influences resulting therefrom.

5. Adequate library facilities, next t efficient staff the most essential feature graduate school, would be more easily vided. The same applies to the third tial, adequate laboratory facilities.

Against the plan of concentration at institution:

1. The centralization of the work, perhaps immediately advantageous, does represent a healthy condition of growth would not be to the ultimate advantag agricultural development in Canada. the need arose for another institutio would be as difficult to establish new ces of support, financially and professi ly, as it is at present for the one instit mooted.

2. Some institutions are specially by their environment to prosecute ce lines successfully. In practice students continue to go where they can secure best facilities for their own particular

3. Most institutions would not agree to renounce graduate work in favour of a central college, since each covets its quota of highly trained men, were it only for the added dignity and tone given to the institution, not to speak of the inspiration derived from their presence in faculty.

4. Graduate work is a great stimulus to research, since a high type of graduate instruction cannot be given without research. It is very desirable to have the spirit and atmosphere of research developed in our colleges. Indeed, few highly trained men would be content to remain where these qualities were absent.

5. The difficulty and expense of securing adequate staff, library and laboratory facilities, is greatly reduced in the case of an agricultural college which forms an integral part of a university and is located on the same campus, in this way having direct access to the facilities of other departments. A number of our colleges have this advantage.

6. On account of the great distances involved, if the work were centralized in one institution, students would be inclined to follow the line of least resistance, and go to a nearer university in the United States, particularly as the trend is in that direction now.

UNIVERSITY CREDIT FOR EXTRA-MURAL RESEARCH

A number of the Committee put forward the important suggestion that some arrangement should be made whereby junior officials of federal or provincial departments of agriculture should be given a certain amount of credit, not to exceed one-third, towards their graduate work, for investigations performed under suitable supervision. Certain men now in the service of these departments might be designated by the universities as competent to oversee this work, or even given formal appointments for the purpose. For example, one of the senior men at the Central Experimental Farm might be technically appointed to the staff of Macdonald College, and oversee the work of his assistants, thus enabling the latter to secure one year towards his residence for the doctor's degree, the other two years to be spent at the institution.

The statement has been made that the Dominion Department of Agriculture experiences difficulty in securing well trained officers. On the other hand, there are undoubtedly many men on the junior list, who only need further training to make them much more valuable. It should therefore be worth while from the Department's standpoint to facilitate this higher training, and to allow such an official to transfer his work, without loss of his entire salary, to some recognized institution for graduate research.

Your Committee presents this recommendation to the Society for consideration and action.

TEACHING SCHEDULE OF INSTRUCTORS IN GRADUATE SCHOOLS

Attention is called to the need for insuring to instructors on whom is placed responsibility for graduate work, a proper proportion of available time for the duties involved. To attempt to add graduate work to a regular schedule of undergraduate lecturing would be fair neither to the instructors nor to the graduate students.

The importance of a proper balance between graduate work and other work was clearly pointed out by a committee of the American Association of University Professors. In the same report American universities were classified on the basis of the number of hours' service given by staff members, and it was shown that the leading universities of the country can be divided into two groups, the second group demanding approximately thirty per cent. more time than the first for instructional work. The above committee points out that the grouping of the universities from the standpoint of time required from staff members also automatically groups them into the first class and second class universities of the country.

It is clear that in the case of a graduate school it is of particular importance to avoid over-loading the teaching schedule of instructors. A large proportion of their time should be free for research.

In presenting the above report of the Committee on Graduate Studies, the chairman wishes to point out that his duties have been chiefly those of a compiler. The information reported as a result of the inquiry conducted was collected principally by Messrs. Dickson, Jull and Moe. Various members contributed to the discussion of the other questions noted.

Report of Committee on Marketing Education.

BY A. LEITCH, (Chairman)

Ontario Agricultural College, Guelph.

Your Committee purposes in this report to deal only with one phase of the problem of Marketing Education, namely, resident instruction in agricultural colleges. In this connection a development of the ideas laid down in the report of the committee for the two previous years is considered advisable. Firstly particular attention might be paid to the departments to which the work of offering marketing courses is delegated and in the next place the character of the courses offered.

Realizing that a number of the agricultural colleges have accumulated some considerable experience in developing courses in marketing it was felt that an examination of these experiences and an analysis of the development and progress of same, would be of some value in assisting us to study the field intelligently and present definite and useful conclusions.

With a view therefore of determining the number of colleges offering general courses in marketing, the number offering specific courses in marketing of farm products, the division of labor between the Departments of Economics and the technical departments in the giving of these courses, the rank and the academic qualifications of instructors, the time devoted to the different courses and the sufficiency thereof or otherwise, and the courses deemed prerequisite to courses in marketing, there was sent to twenty-seven agricultural colleges in the United States and to seven Canadian colleges a questionnaire, asking for this information.

This questionnaire was sent directly to the presidents, principals and deans of Agricultural Colleges. Replies were received from twenty-two out of the twenty-seven United States colleges, and three out of the seven Canadian colleges. Since preparation of this report two American and one Canadian Colleges have reported.

It was discovered that twenty of the twenty-two United States colleges and all three of the Canadian colleges were offering general courses in marketing. By general courses Marketing is meant, the academic treatm of the following subjects—the consumpt requirements of people, the nature of th requirements, sources of production of th requirements, the technical phases of va and price, the services necessary and agencies performing the services of filli the above requirements, all without speci relation to any particular commodity.

From the answers to question 3, which lated to courses in marketing specific fa products it was discovered that twenty-o out of the twenty-two colleges offered th courses in Departments of Economics. addition nine colleges offered courses marketing in the technical departments. T 21 departments of economics offered a to of 48 courses in the marketing of speci farm products. In the nine colleges wh part of the work was done by the commod departments, animal husbandry departm gave four courses, the horticultural depa ment five courses, the poultry department fo courses, the dairy department five cours agronomy department one course, a total nineteen courses. In all cases the ab courses were those given to graduate stude only.

Among the Canadian colleges the wo appears to be about evenly distributed tween the departments of economics and commodity departments. In all three of colleges, work of this nature was given both departments of economics and techni departments. Three departments of ec omics offered four courses, and five cour were given by the departments of anim husbandry, poultry, horticulture and agr omy.

In order to establish a uniform basis which time could be compared, all colle were put on a basis of hours per week fo term of thirteen weeks. Among the 48 cour given in agricultural colleges by departme of economics it was found that there w two one hour courses, sixteen two hour co ses, and twenty-eight three hour courses,

our hour course and one five hour course. The 19 courses given by commodity departments in the U. S. Colleges consisted of two ive hour courses, ten two hour courses, four hree hour courses and two four hour courses. n the Canadian colleges the departments of conomics gave one two hour course, one hree hour course, one four hour course, and ne half hour course, while the technical departments offered two hour courses and three ne hour courses.

The views of the various college authorities in answering the questions relating to he adequacy of the time devoted to this subject are extremely interesting, especially as hey denote what may be considered the ptimum time that this subject requires under resent circumstances. Eleven of the American colleges answered that there was not sufficient time and from two others no reply to hat question was received. A further study f the replies in this connection discloses hat the eleven colleges which appeared satisfied with the length of time allotted were ffering an average of four courses per college of an average length of 2.9 hours per veek while the other eleven offered two courses per college of an average length of two ours per course. As there was every indication in the replies that the different departments interested concurred in the various eplies there is ground for fairly assuming hat, under the present development of the ubject, the work of resident instruction in narketing can be adequately provided for on ollege calendars by allowing time to the otal extent of twelve hours per week for one erm, or four three hour periods.

The rank and academic qualifications of the nstructors giving courses in marketing is interesting though not vital to a consideration f the whole question. In the American colleges the work of instruction by Economics epartments was performed in the 48 courses y twenty-seven professors, fourteen assistnt professors, and eleven graduate assistants. t might be pointed out here that among assistant professors are included the ranks commonly known as associate professors and ecturers in this country while the work of raduate assistants includes those in rank nown here as demonstrators, fellows, etc. he academic qualifications of the above instructors were as follows: Eleven Ph.D's, sixteen Masters, sixteen Bachelors, and nine not specified. The work of instruction in marketing among the commodity departments was conducted by six professors, eleven assistant professors and three graduate assistants whose academic qualifications were: one Ph.D., five Masters, eleven Bachelors and three not specified. It might here be noticed that all classes of departments considered this work of sufficient importance to delegate it to the more experienced men. That there is a larger proportion of men of advanced degree offering this work in the departments of economics than in the commodity departments may be due to the fact that agricultural economics is a comparatively recent study and such departments are usually manned with men who have graduated within recent years during which preferences have been shown to men with advanced degrees.

Among the Canadian colleges courses given by departments of Economics were given by two professors and two assistant professors of whom three were Masters, and one was a Bachelor, the courses offered by commodity departments were given by five Professors and one assistant professor of which four were Masters and two Bachelors. Canadian colleges also recognize the desirability of delegating this important work to their more experienced men.

With regard to academic courses deemed prerequisite to courses in marketing, all colleges were unanimous in naming general economics as the first prerequisite. In addition three colleges mentioned agricultural economics, two industrial geography, three technical subjects relating to the commodity concerned and one named transportation.

It was deemed advisable to discover the degree to which experience had justified the consolidation of resident marketing instruction into one department organized for that purpose, or, to state it in another way, whether in the colleges which had accumulated experience in giving marketing courses, the trend of course organization and development was toward specialization in a department of Economics or distribution among the technical departments, each covering the marketing problems of its own commodities. This idea was the substance of item 5 in the questionnaire. In this connection the replies of seventeen out of the 22 U.S. Colleges was

that development out of their experience was along the line of limiting marketing courses, as such, to departments of Economics; the remaining five were not prepared to commit themselves definitely on this point but all expressed the desirability of confining all instruction in principles to Departments of Economics and leaving practices and methods to the commodity departments. Such also is the view of most of the Canadian colleges.

To understand better the probable reasons for the marked preference for marketing courses by economists rather than by technicians it will be necessary at this point to make an excursion into the subject matter of marketing. No argument is necessary on the especial principles of general economics that underlie marketing processes and that have a practical application to marketing problems such as value, price, law of supply and demand, exchange and banking. These, it is granted, belong to the field of economics and are common to all commodities. Marketing itself is the rendering of certain services by certain agencies. If we first isolate the services we may arrive at an intelligent comprehension of the relation of these services to the subject matter of the various college departments concerned in the problems of marketing.

These services are: 1 Assembling; 2 Grading and Standardizing; 3 Processing; 4 Packaging; 5 Transportation; 6 Storage; 7 Financing; 8 Distribution.

Let us now see how far the methods and practices in the physical production and distribution of commodities, the undoubted field of the technical or commodity departments, apply in the actual consideration of these various services. Practices and methods in grading, standardizing and packaging and to a somewhat less degree in assembling, are distinctly and closely related to the subject matter of commodity departments and any division of the labor of instruction in these phases of marketing will allocate the work of instruction largely to those departments. That the usual subject matter of commodity departments has such a clear contact with the other services is difficult to see. Processing is conducted usually by business enterprises strictly disassociated from agriculture; so is transportation except such as is made use of in local assembly. Storage except on a farm or immediate local warehouse is a business by itself and usually far remov from actual producer contact except as r gards suitable grades and varieties, while fi ancing and distribution clearly belong to t field of the economist who also has a som what looser contact with those phases abo allocated to the technical man.

A consideration therefore of the abo facts leads to the conclusion that the econo ist can best deal with the instruction relati to services, except those closely connect with the actual physical characteristics of t commodities, assembling, grading and stan ardizing and packaging, which are the pro ince of technicians. Division of labor market services between such departmen appears to be an essential condition with t delegation of those features that concern t physical characteristics of the commodities technical departments, while all other ma ters relating to organization, financing a costs of these services can without duplic tion be despatched by departments of ecc omics.

Looking now to the phase of marketi agencies, whether they be private, co-oper tive or governmental, we find that this fie lies entirely within the purview of the Ecc omist. How the various classes of middlem function, their relation with each other, th number, their efficiency, their place in t fabric of society, are questions of politic economy almost entirely.

In the opinion of the committee and view of the facts just stated, it is difficult, a the committee will not presume to do it, lay down exact recommendations that any every college might follow in developme of marketing instruction. Modern tend cies of development point out that the bro question of marketing lends itself to sou est, most rapid, and least expensive grow when taken in general charge as to princip and in particular care in all practices a methods except such as are noted above, departments of economics.

In conclusion the committee wishes to firm that in any development of instructi in this subject, in any college much m be left to the local conditions and particul ly to the individuality of the staffs concern On this individuality rests largely the re tation and success of all colleges, so above discussion is not intended in any se to be finality.

etrissure et Pourriture de la Tige du Tournesol Dans la Province de Québec.

BY B. BARIBEAU

Laboratoire de Pathologie Végétale, Fredericton, N.B.

e tournesol (*Helianthus annuus*) est ap- à tenir une place très importante comme ilage dans l'Est du Canada. Il existe des uves en nombre suffisant pour que nous ssions dire que le tournesol (soleil) place utilement maïs (blé-d'inde) dans districts où les conditions climatériques posent à la bonne culture de ce dernier. rouille ou autres maladies du feuillage vent quelquefois causer une légère réduc- de la récolte comme valeur fourragère, is généralement cette plante est considérée me exempte de maladies. Durant l'été 1921 et 1922, la maladie mentionnée ci-sus a pris une certaine importance dans e Province (voir fig. 1-).

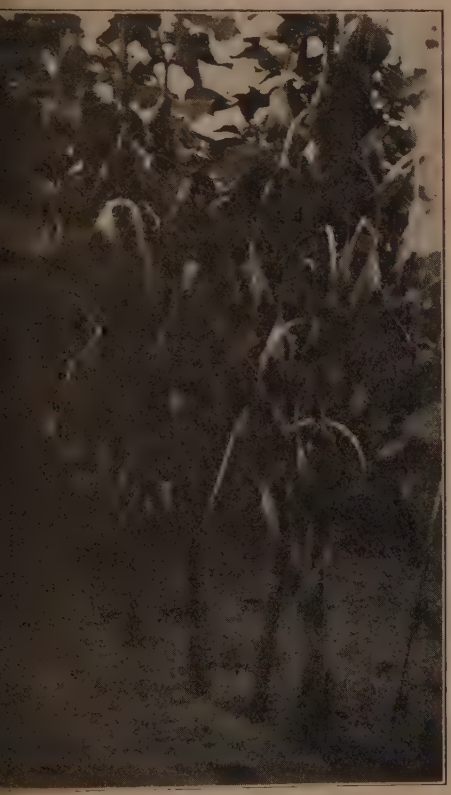

Fig. 1—Apparance d'un champ malade. *Photo, B. Baribeau, le 14 aout, 1921.*

La pourriture de la tige du tournesol fut trouvé par l'auteur, en plusieurs districts, specialement à la Station Expérimentale de Ste Anne, le 14 août 1921 et de nouveau le 2 août 1922. Heureusement, d'après les rapports, la maladie ne semble pas être grave sur le tournesol dans cette province, du moins jusqu'à preuves plus probantes.

Durant les dernières années, les maladies des sclérotes ont été signalées dans plusieurs pays. Lawrence de l'Etat de Washington, signale une maladie sur le tournesol qui d'après lui est le *S. Perplexa.* Cotton en Angleterre signale une maladie de la pomme de terre qu'il attribue au *S. Sclerotiorum,* il a trouvé une maladie semblable produite par le même parasite qui s'attaque à la tomate, au haricot, carotte navet etc. En 1920, on a trouvé fréquemment la maladie dans l'Oregon, Washington, Manitoba, Ontario, et en 1921, l'auteur signale la maladie dans cette province. En 1922, Monsieur F. L. Drayton, de la Division de la Botanique d'Ottawa, m'informe par correspondence que cette maladie se rencontre assez fréquemment à la Ferme Centrale.

Symptoms de la maladie.

Comme l'indique le nom donné à la maladie, les tiges pourrissent. Les plantes sont atteintes par la maladie quand elles ont une hauteur de 5 à 6 pieds, c'est alors qu'elles se flétrissent se dessèchent et ne tardent pas à mourir. La température et autres facteurs semblent éliminer l'infection des jeunes tiges. Au début de la maladie, les parties atteintes se recouvrent d'un épais feutrage blanchâtre, avec une décoloration des tissus de la tige, le tout apparaissant au niveau du sol ou un peu audessus et quelquefois jusqu'à une hauteur de 3 pieds. Plus tard, si la température est humide, il se produit du mycelium en abondance avec un développement de petits tubercules, habituellement irreguliers, ayant différentes grosseurs (voir fig. 2-) Au début, ces derniers sont blanchâtres, ils noircissent

Fig. 2—Tiges malades, a.-sclerote; b.-mycelium.
Photo, B. Baribeau, aout, 1921.

Fig. 3—Mycelium et sclérotes à l'intérieur d'une tige de tournesol.
Photo, B. Baribeau, 1921.

et finalement ils tombent sur le sol. Le mycelium pénètre graduellement dans l'intérieur des tissus et gagne la moelle. Il se forme dans le moelle une croissance rapide du mycelium avec formation de nodosités dans l'intérieur des tiges du tournesol. On ne peut les voir qu'en brisant les parties atteintes, (voir fig. 3-) ces nodosités s'appellent sclérotes: mycelium du pathogène en repos. Les sclérotes forment le thalle végétatif du pathogène, lequel peut ainsi rester plusieurs années dans le sol et communiquer de nouveau la maladie. S'il y a beaucoup d'humidité, la tige devient flétrie et il lui arrive de choir sur le sol en cédant à l'endroit affecté. On a trouvé fréquemment la maladie des sclérotes sur les fèves et les navets; en 1919, le *S. Libertiana* causa des dommages assez appréciables à la récolte des fèves de la Station Expérimentale de Ste. Anne. L'infection provient d'un champ infecté d'une récolte malade.

Sclérotes hibernant dans le sol.

Il est important de savoir si les sclér qui gisent dans le sol pendant l'hiver peu transmettre la maladie d'une année à autre. Durant l'hiver de 1922 et 1923, exposé sclérotes de la tige du tournesol geléen mettant les sclérotes dans un récip contenant de l'eau que j'ai laissé geler c plètement: la température descendit à dégrés au-dessous de zéro plus d'une Après les avoir laissées plus de huit sema dans ce bloc de glace, j'ai examiné sclérotes et je les ai trouvées parfaiten normales, (chaque année) mais, bien enten elles ne donnaient aucun signe de germ tion. Je les ai alors fait germer dans cultures artificielles et elles développè du mycelium et des sclérotes en abonda Dans une autre expérience du même ge des sclérotes sèches ont été exposées gelée et leur germination n'en a pas plus souffert, On voit donc que les gra

ids n'affectent pas la germination des rotes, qu'elles soient sèches ou humides.

Longévité des sclérotes.

Des sclérotes détachées et non-détachées des s du tournesol conservent leur vitalité dant plusieurs années, au moins deux ; des sclérotes de 1921, conservées à une pérature de 68 à 75 F. développèrent en il 1923 sur Agar-patate, du mycelium en ndance. La longévité des sclérotes du rnesol est importante pour le champignon même. C'est une adaptation naturelle conditions du milieu dans lesquelles s vivent. Si les sclérotes ne devaient ex- r que peu de temps, les chances de re- duction seraient très limitées, ce qui n'est naturel. Le but de la sclérote ou de la ine est de se reproduire, et c'est également raison pour laquelle les sclérotes vivent gtemps.

Culture artificielle.

Les sclérotes de la pourriture du tournesol, après avoir été stérilisées et lavées dans de l'eau distillée développèrent du mycelium et des sclérotes en grande quantité sur Agar-patate mais le développement est plus rapide sur une surface de carotte stérilisée. Le mycelium croit en longeant la surface de la culture, en ayant une couche blanchâtre à pousse basse. Les sclérotes formées dans la culture artificielle sont semblables à celles que l'on trouve sur les tiges du tournesol et à leur intérieur, mais elles diffèrent un peu en grosseur. J'ai essayé de faire fructifier en milieu artificiel du matérial prélevé à 4, 6, et 12 pouces au-dessus de la partie malade d'une tige de tournesol, mais dans chaque cas, j'ai obtenu des cultures stériles. Il est évident que la maladie n'est pas systématique. (not systemic).

Fig. 4—Carrotes, 7 jours après l'innoculation.
Photo, B. Baribeau, 1922.

Fig. 5—Onion, 2 semaines après l'innoculation.
Photo, B. Baribeau, 1923.

Innoculation.

Des carottes, des onions et des navets furent innoculés avec du mycelium provenant de l'intérieur d'une tige de tournesol croissant sur Agar-patate. L'infection des carottes fut beaucoup plus rapide que celle des onions et des navets (voir fig. 4, 5-).

Sur la carotte le mycelium prit pied et détruisit les tissus en moins de trois semaines, développant un épais mycelium avec une grande quantité de sclérotes. (voir fig. 6-).

Fig. 6 6 semaines après l'innoculation.
Photo, B. Baribeau, 1923.

Sur l'onion, le mycelium superficiel était abondance au point d'innoculation, il pénétré les tissus qu'il couvrait mais il s'est pas étendu. Des plants de patates f ent innoculés, mais les essais furent infr tueux jusqu'à date. L'innoculation sur jeunes tiges de fèves, cause la mort. sclérotes pour la plupart restent dans le à l'état dormant durant l'hiver et attend le commencement de l'été pour germer, d nant naissance à des apothécions qui port les ascospores renfermant les spores qui fectent les autres tiges. Les sclérotes peuv passer l'hiver dans le sol, et au commen ment de l'été développent un mycelium peut infecter les plantes, ce qui a été dém tré plus haut au moyen d'innoculations. J essayé plusieurs moyens de germination, m aucun apothécion n'a été observé. Il a l de croire que le champignon causant maladie du tournesol est identique au *Libertiana*, mais diffère du champignon ca ant la maladie des sclérotes sur les patat

Control: Importance des assolements

L'assolement ou la rotation des cultur de manière à ce qu'aucune plante susceptib ne soit accessible au champignon pend plusieurs années, est un facteur import dans la prévention de cette maladie. lever et détruire avec précautions toutes parties de plantes malades, eviter de jeter parties infectées sur le tas de fumier; qui équivaudrait à introduire des scléro dans un milieu de culture: tout comme n le faisons en Laboratoire. Les sclérotes résultent d'une récolte infectée peuvent ter dans le sol en hiver, germer au co mencement de l'été et propager l'infection tournesol ou aux plantes susceptibles l'on pourrait planter la deuxième année.

Compte Rendu de la Convention Annuelle.

Un rapport complet de la convention sera publié dans le prochain numéro de la Revue. Nous regrettons que le temps ne nous a pas permis de publier ce rapport en français dans ce numéro.

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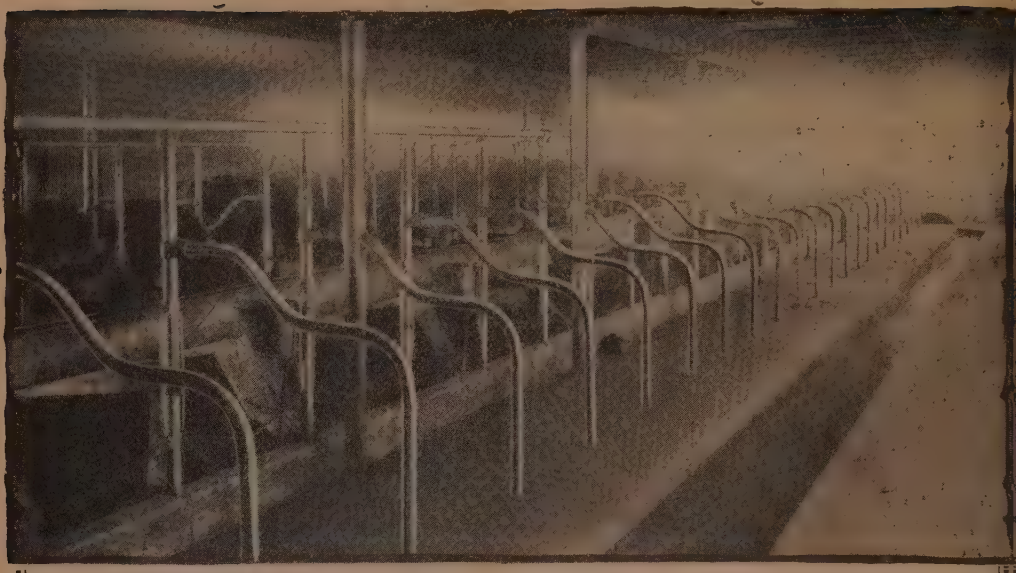

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Division of Work Between Agricultural Departments and Colleges.*

BY F. HEDLEY AULD,

Deputy Minister of Agriculture for Saskatchewan.

propose to refer especially this evening a question which has already received ie consideration from the Canadian Soc- of Technical Agriculturists namely, icies of Departments and Colleges Agriculture. I do not for a mom- believe that present conditions are ideal that ideal conditions can easily be made l, but I do think that if we all realize at is ideal we can more easily and more ctively operate to realize those conditions.

Let us for the present imagine that we e no personal relation to the problem, we are not officially connected with ier Federal or Provincial institutions and refore able to consider this as an abstract blem. Let us imagine that we are mem- s of a committee called upon to investigate problems of Agricultural Education and ministration in Canada and, if you will, re-organize these services so that each ild be carried on under the proper aus- es and without duplication.

A survey would disclose a great divergence methods. We should find research work soils and crops carried on by both Fed- and Provincial institutions. We should extension work in agriculture a function Agricultural Departments in some provin- and of agricultural colleges in others. We uld find: Cow Testing Associations pro- ed in some cases by Provincial Depart- t; Crop reports prepared and issued by the eral Department of Trade and Commerce by Provincial Departments of Agricul- ; both Federal and Provincial Depart- ts of Agriculture paying grants to certain icultural fairs; the Soldier Settlement rd and the Provincial Department main- ing agricultural agents; Federal and Provincial Departments doing extension work in promoting live stock and poultry—a form of agricultural representative work; Federal and Provincial Departments providing a butter grading service.

Other examples might be cited.

Is there any rule to guide us as to the proper auspices under which to conduct such work?

The Fathers of Confederation with the example of the English speaking races to guide them, drafted a system of government for this Dominion which gave certain duties and responsibilities of a national character to a Federal Parliament and a National Executive and left to our Provincial Legislatures and Governments responsibilities of a local nature. In respect to some of these, such as defence, customs, and education, there is no confusion as to the proper authority, for in relation to these the constitution permits no duplication of authority and no division of interest. But in relation to agriculture, both Federal and Provincial Legislatures have authority to legislate, with the proviso, however, that "any law of the legislature of a province relative to agriculture or to immigration shall have effect in and for the province as long and as far only as it is not repugnant to any Act of the Parliament of Canada." The authority to legislate also implies the authority to administer laws, and thus we have two sets of bodies interested in this great question of agriculture and liable

*An address at the Provincial Government Banquet, C.S.T.A. Convention, June 22, 1923.

also to clash both in legislating and in administering.

If the assumed functions of Departments of Agriculture were limited to the administration of laws and regulations I would proceed at this point to draw some conclusions. There is also involved, however, the question of education, and in regard to education the power of the Provincial Legislature is supreme. Our constitution says, "In and for each province the legislature may exclusively make laws in relation to education, subject and according to the following provisions, etc." The late Dr. C. C. James commenting upon this in a report to the then Federal Minister, which report was published by parliament, said: "On this authority the carrying out of educational plans belongs exclusively to the provinces, while the Dominion work along other lines is paramount. It seemed, therefore, in making provision for special help for the provinces, that it was advisable to give that help along those lines that were by statute exclusively reserved for the provinces."

If Dr. James was correct, then we can first conclude that agricultural education is a function of the Provincial institutions and not of the Dominion Department of Agriculture. If education is a function of the province then it includes all lines of education, not English, or history, or mathematics, but science including agricultural science in all its branches as well. And if teaching a subject be known as "education" so also must the research on which such teaching is based be regarded as education.

The next conclusion would be that all educational work either of research or of teaching which is carried on by the Federal Department should as a matter of propriety be done by provincial institutions and, therefore, if we are to avoid duplication of activities in educational affairs we must recognize this basic fact: that educational work is primarily and properly a function of the provinces.

But upon investigating further our Committee would find all of our Provincial Departments of Agriculture more or less engaged in the promotion of educational work in relation to agriculture. Some of the P vincial Departments would affirm that it quite proper for them to be so engaged; if we are to avoid duplication of effort will be necessary to determine the pro auspices for educational work, whether in nature it be experimental or extension wo

It seems to me that the chief object establishing colleges of agriculture is to h agricultural education receive better att tion than was possible at the hands of a cultural departments. Agricultural edu tion includes research and teaching. U this I believe all will agree. I am going ask you to agree further that it includes tension activities—for the man whose c days are over. If this be true the only to have a clear-cut policy in agricultu education is for those provinces which h colleges of agriculture to put all phases agricultural education in the hands of college authorities, including research extension as well as teaching. In our ef to establish a guiding principle and from foregoing we may conclude that the funct of a college of agriculture is educational the function of a Department of Agricult is administrative, and that we may by standard determine whether any given lin work should be promoted by a College Agriculture or by a Department of Agri ture.

One might suppose that it would be eas agree upon such principle and to bring ab a re-organization which would properly locate all educational and administra problems of an agricultural nature. W would our investigating committee proba find?

They would probably be confronted v the fact that many of our institutions h like Topsy, "just growed", but with porti of their organic structure less appropr than Topsy probably possessed. They wo also be obliged, I am sure, to conclude in any reorganization expediency rather t principle would have to be followed in m cases. Let me illustrate with the experi tal farms system. Our committee would l ly find very few of the provincial coll able to finance the management of the eral farms, and some of them reluctant t

It is interesting, however, to recall the ment of Dr. Grisdale to your annual con- ion a couple of years ago, that when provinces want the experimental farms Federal Department will be ready to turn over. Practically that offer might as much as would an offer from Presi- Beatty to turn over the Canadian Paci- Railway to me whenever I had the cash ay for it. My point is that very few of provinces are in a position to assume the onsibility. There are other lines of which would be less difficult to trans- such as research work with animal and t diseases and parasites. It is possible, ever, that it could be shown so clearly one central agency under the auspices he Federal Government could more econ- cally undertake this work for our coun- than by having several agencies engaged that the demand would be for the Fed- Department to undertake research in tion to such problems as those which n settled for one district would be settled the whole country. That, however, is true of many of our problems relating oils and crops. The existence of a large ety of soils and seasons makes many of research problems in agriculture dis- ly local.

What would our committee find in rela- to the division of work between the Fed- and Provincial Departments of Agri- ure?

would find first, divided opinion on the of the Provincial Departments of Agri- ure as to the work which they should do. of course is natural on account of the ed agricultural conditions across Can- But I think in this matter of adminis- ion a principle can be found which like olitical platform, may at least indicate t direction should be followed. I take at if it were feasible to govern Canada the Federal Capital there would have no provinces and no municipalities. All s would be levied from the national capi- All departments would be centred e. When any agricultural, legal, or cational problem arose it would be re- ed to headquarters for solution. The ers of Confederation, however, had the experience of other countries to guide them and they provided for local self government, realizing the utter impossibility of getting along with a concentration of legislative, administrative, and educational functions at the national capital.

And if we thus have local institutions such as legislatures, municipal councils and universities, it is because they have been found necessary to serve the people for whom they were founded. If this conclusion is correct it should follow that the division of responsibility between Federal and Provincial Departments would be determined on the basis of what is a local and what is a national responsibility. There is, I submit, a natural division which I can illustrate by a few examples. The inspection of animals, plants, and seeds imported into Canada and the enforcement of quarantine regulations, the control of stock yards, the investigation of markets, the grading of produce for export, are lines of work which I believe are rightly under Federal auspices. Among others which rightly should be carried on by Provincial Departments are live stock promotion work generally, including promotion of the use of better sires, poultry culling, grading and licensing of stallions, registration of live stock brands, control measures in regard to field and garden crop pests, promotion of co-operative marketing, publication of crop reports, etc.

Difficulties will no doubt be found in dividing work between Federal and Provincial Ddepartments of Agriculture and between Provincial Departments of Agriculture and Colleges so exactly as to follow the lines which I have laid down as basic, but if both parties desire a proper division it can be found. In the past, one of the difficulties in the way of a clear cut division in our agricultural work was a certain type of politician (probably now extinct) who used administrative differences for political purposes instead of

striving to overcome them. Another difficulty is the ambition of administrators—and it is a failing of which Technical Agriculturists have neither a monopoly nor entire freedom. The average civil servant is ambitious to increase his influence, to build an efficient organization, to render an important service. It is not easy for an ambitious executive to transfer to another department or another institution a line of work which will lessen his staff or affect his influence. Yet if we are to be true to the public whom it is our aim to serve, it may have to be done if we are to avoid duplication of effort, and make our work thoroughly effective.

Another difficulty in the way of a uniform policy lies in the fact that all of the provinces are not equally able financially to undertake local responsibilities. What might be easy for Ontario or Quebec might prove very difficult for some other province, so that I am disposed to think that if a guiding principle can be established which will enable us to determine to what institution a given function should pertain, we have made progress; and that considerations of expediency which affect the parties directly concerned must thereafter determine by whom the function is to be assumed. Saskatchewan, Manitoba and British Columbia have assumed the promotion of cow testing, which I regard as a purely provincial function, while other provinces have not done so. Saskatchewan has maintained that the promotion of live stock and poultry is a line of work which is of a local character and therefore a local responsibility. Other provinces have decided differently. Some provinces will undertake local work which they feel they can finance, while leaving to the Federal Department other activities equally local in their nature. I think therefore that a uniform policy is neither essential nor possible. In fact I am not sure that absolute uniformity is desirable. The necessary variations of the Provincial Departments of Agriculture in their lations with the Federal Department show the merits of the various method reaching a common objective. I wish, ever, to set up a standard by which one determine whether an agricultural activit properly the function of the Federal Dep ment, a Provincial Department or a Col of Agriculture. If I can do that and l to the Provincial Departments of Agricul a measure of self-determination in deci whether they wish to undertake local ministrative activities, I shall be content

Let me summarise by saying that the eral Department of Agriculture has funct which it alone can perform. Provincial partments and Colleges of Agriculture local duties and responsibilities which alone cannot perform as efficiently as al us would like and in connection with w the Federal Department may feel a res sibility. We have a case in point in nection with the Federal grant for agr tural instruction, the Federal Departm undertaking to assist a purely provin activity by providing cash subsidies to en the provinces to extend and speed up their work. Possibly there are other ac ties for which the Federal Department a special responsibility. If so, I can ha conceive of the provinces being unwil to accept assistance from the Federal Dep ment along the lines of the precedent w they have already voluntarily establishe connection with the Agricultural Instruc Grant. But whether a realignment of ac ties on some such basis as I have sugge develops or not, I know no reason wh this great work for the development of culture, there should not be the fullest sure of harmony between all of the offi concerned, and I regard the Society of T nical Agriculturists as being in a very orable position for promoting such fellowship.

Some Forage Crop Problems of the Northern United States.*

BY A. J. PIETERS

Office of Forage Crop Investigations, Department of Agriculture, Washington, D.C.

The term forage crops is used here in the oad sense to include all crops harvested r hay or fodder or grazed off. The United ates Census gives the figures for acreage id production of various hay and coarse dder crops and these are commonly con-dered as being the harvested forage crops. efore discussing some of these crops in rticular it may be well to get a notion of e extent of the forage crop interest and w it compares in acres covered, with cer-in other standard crops. The area which e have especially under consideration is at North of the Ohio and Potomac rivers id North of the Kansas-Nebraska line. This vision is arbitrary and approximate, but general the forage crop situation in the uth is markedly different from that in the orth and is presumably of less interest to y present audience. In the Northern States e forage crops grown are to a large ex-nt the same as those used in Canada.

Taking the area by sections the percentage acreage of all crops harvested from which rage crops are harvested is as follows:

TABLE I.

ew England States	76.8
. Atlantic States and Maryland and Delaware	47.6
N. Central States	29.6
. N. Central (in part)	25.8
ontana, Wyoming and Idaho	46.6
ashington and Oregon	31.6

In the whole area more than 30% of the nd devoted to harvested crops is used for e production of hay and fodder.

But if we are to get a true view of the agnitude of the business of providing feed r our live stock we must consider that rn, while classed as a cereal, is almost all d to stock, that oats and barley are likewise used and that wheat, rye, soy beans and various waste orchard, potato and other products are fed to stock. When these feeds are considered we have figures of still greater magnitude to represent the area of land that is devoted to producing feed for live stock.

Various specialists at the U. S. Department of Agriculture have estimated the proportions of various crops that are fed to cattle.

Applying these figures to the area in question we find that in the various states the percentage of the total acreage of harvested crops devoted to feeding live stock is as follows:

TABLE II

New England	91%
Middle Atlantic	79%
E. N. Central	76%
W. N. Central	70%
Mountain States	70%
Pacific Coast	60%

You will note that as a whole about three-quarters of the acreage of harvested crops is used to produce feed for live stock.

For a broad view of the forage crop situation it will be useful to consider the relation of the forage to live stock. In order to arrive at a common unit all livestock has been figured to a basis of one unit: the adult cow. For this—5 swine—7 sheep and goats —1 horse or mule=1 cow. Summing it up we have an animal population in the entire United States of 114,000,000 units exclusive of poultry. (I cover the entire U. S. in these figures since they have been worked out on that basis and there was not time to work out new figures.)

*This article and the one following, on "Clover Problems", were submitted, as lectures, at the third annual Convention of the C.S.T.A., Saskatoon, Sask., June, 1923.

Using the Danish Feed tables and applying these to the total quantities of all kinds of harvested animal forage produced we find that this will feed 50,000,000 animals or about half the total. We infer, therefore, that the balance of the feed comes from pasturage. Figuring from the pasture end, the data for which are extremely meagre and unsatisfactory, we find that the estimated pasture acreage will feed 57,000,000; again roughly half of the total animal units. From a consideration of these figures we feel justified in saying that the pasture problem is a large one—it furnishes half the feed for our livestock or as much as all harvested forage put together, and this requires three-quarters of our acreage to produce.

In the present discussion we shall confine ourselves to the hay and fodder crops and pasturage as these are the ones covered by the work of the Office of Forage Crop Investigations.

The region under consideration is a large one and, as is likewise the case in Canada, the most striking climatic difference between various parts of this region is rainfall. The East is a humid section. After one crosses the 98° of longitude one enters an area of scanty precipitation. Further west altitude enters as a new factor, while on the Pacific coast again we have humid conditions. These differences are reflected in the forage crops grown in the various regions.

The chief hay crops harvested in this region are clover, timothy, alfalfa, wild hay, grain hay, annual legumes and miscellaneous tame grasses. Of these crops timothy and clover, either alone or mixed, are the great forage crops in the East while as we go West we find the production of alfalfa increasing until west of the 98° of longtitude it quite forces timothy and clover from the field. The production of wild hay shows a peak in the W. Central and N. Great Plains states.

The important problems in the Eastern States are associated with red clover. The farmer who can grow good clover has few worries either as to feed supplies or soil productivity. Clover has, however, not done so well in the past 20 or 30 years as it did when the country was new.

The clover problems will be taken up the next lecture.

Timothy.

Timothy produces more than twice much hay as all other tame grasses, b annual and perennial including grain h While it is the most important grass in United States there are no special proble The U. S. Department of Agriculture ma tains a timothy breeding station at which r strains are being developed and one, Huron, has already been distributed.

Alfalfa.

In the Eastern States the progress of alfa culture has been slow and so far as we see this crop will always be second to clo in this region. Alfalfa does not endure humid climate well, and it does not thrive der such conditions the way it does in the W There are good fields in the East but troub are many—South of central Pennsylvania is subject to "yellows", cause unknown, a this limits the life of the plant.

There are also cases where excellent falfa fields have gone out and it has not b possible to re-establish a good stand. We trouble alfalfa in the East and blue gr runs it out on the better lands which also the ones to which alfalfa is b adapted. Hardy varieties are useful and deed necessary in the Northern part of area, where such varieties as Grimm recommended. Whether some new vari specially suited to the humid East will app is for the future to determine.

Intensive work has been done to int duce alfalfa in some of the Eastern Sta and yet after more than 25 years of eff New York State produced in 1919 but 2.3 of the total alfalfa hay in the region un discussion, Pennsylvania less than 1%, states of New Jersey, Delaware and Ma land together less than 1%, Ohio 2 Michigan and Minnesota 1.3% each a Wisconsin 1.6%. While alfalfa will course make headway, it does not seem pr able that it will ever become a leading crop in the humid East.

Sweet Clover.

This crop has made considerable progress the last 20 years, but we have no means determining the acreage planted. The eatest increase in acreage has been from linois, west and northwest, and the greatest e of the crop is for pasture. With this op we have problems aplenty but the most nportant is the utilization of the crop. The st crop of the second year's growth is rd to cure properly and as a consequence does not commonly make good hay. Re-nt experience in N. Dakota has shown at mouldy sweet clover hay may be dan-erous. Where the fall crop can be cut good y is made and in such cases the first growth spring is often turned under for corn. weet clover lends itself especially well to asturing. The spring growth is rapid and nder and by the time the stalks are get-ng woody, usually in July, the new stand n be pastured. This allows the older lants to reseed. By proper management of vo fields a permanent sweet clover pasture n be had.

The forage crop problems of the Northern reat Plains are such as arise because of eficient rainfall. The U. S. Department of griculture has for some years maintained ations at various points in this region and me of the results from the work at these ations have been written up by Oakley and Vestover who have kindly placed in my nds the manuscript of their work. Most the following data have been extracted om that manuscript.

It is clear that if this section is to prosper ain growing must to a large extent give ay to stock raising, and the stock raiser will eed more forage than the native grasses will roduce.

Alfalfa is naturally an important crop and n be grown wherever the rainfall is not o small. Over a 5 year period the yields Grimm Alfalfa have ranged from the min-num of .2 ton at Havre, Mont., to 1.8 ton Redfield, S.D. Carefully conducted tests ve failed to show any superiority of Cos-ck or other hybrid forms over Grimm.

Various problems connected with Alfalfa lture in the Northern Great Plains have en studied. It has been found that seeding between May 1 and 16 gives the best results, one of the great advantages of delayed seeding being the destruction of weeds.

The relative advantages of row, drill or broadcast seeding have been studied. At Moccasin, Sheridan and Mandan there has been practically no difference between the yields from row or broadcast seedings. At Havre in very dry years the row method has produced a little the most but the total yields during these years were less than one half ton per acre, an amount below profitable production. Even where the yields from row seedings have been slightly greater the added cost of cultivation and the poorer quality of the hay make this method unsatisfactory.

The time of cutting is important. In a very dry time it seems to be better to let both weeds and alfalfa grow during the first season rather than to clip. Under such treatment a larger root system is developed the first year and the weeds and alfalfa furnish winter protection. After the first year cutting too early or too often is quite sure to shorten the life of the stand. Graber has found the same thing to be true for Wisconsin. The first cutting of the season should not be made till the plants are well in bloom and care must be taken not to cut too late in the season.

A very important factor in forage production in the Northern Great Plains is tonnage and, except at high altitudes or in the extreme north, corn has proved to be the most reliable producer of tonnage.

Sunflowers have been advocated for this section but at our stations corn has produced the greater dry weight if not always the greater amount of green weight. At high altitudes, where the season is short, sunflowers are better than corn but generally they show no advantage over corn which is the standard silage crop for this section.

Of the grasses, awnless brome is the only perennial grass that has shown value on dry land, and over much of the area even this grass has not given profitable yields. In dry years satisfactory yields cannot be expected in the Western part of this region.

Mixtures of brome grass and alfalfa have been tried but have not been found profitable.

The yields of alfalfa alone have been appreciably better than the mixture. Slender wheat grass (*Agropyron tenerum*) and crested wheat (*A. cristatum*) have shown promise, especially the latter. The average yields have ranged from .5 ton at Hettinger and Havre to 1½ tons at Mandan and Edgeley.

The grazing problems of the Western range lands have been studied by the Forestry Bureau which has supervision over the grazing in the National Forests. By careful selection of the kind of stock best suited to a given range and care against over-grazing, these range lands can be maintained in fair shape, but one important need is the introduction of new grasses from the interior of Asia. There is good reason to believe that grasses may be found in the high, dry interior of the greatest continent that would make their way on our semi-arid lands a materially add to the grass supply.

The pasture problem in the Eastern States l never had the attention it deserves. Reme ber that one-half of our live stock is f from the pastures and that it requires th quarters of our cultivated land to prod feed for the other half and you will get idea of what might be accomplished adequate studies of our pasture proble Some of the work done points to the c clusion that good blue grass pasture is m commonly under than over grazed, and t under grazing in spring is a frequent ca of over grazing later in the season. Th problems will need to be taken up in future if our pastures are to feed all animals they are capable of feeding.

Clover Failure.

BY A. J. PIETERS

In the previous lecture this was touched upon as the big problem for the entire North Eastern United States. It is true that clover failure is not yet serious in such states as Wisconsin, Minnesota, and Iowa, but the complaint is moving west just as it has done for more than 100 years. As long ago as 1747 Jared Elliot wrote that the worn out land would not produce good clover any longer. In 1820 "clover sickness" was noticed in Pennsylvania, in 1866 it was reported from Ohio. It was natural that those who early observed the failure of red clover should use the English term "clover sickness" and consider it some mysterious visitation connected in some way with the continuous growth of clover. English and European students long disputed about the cause of clover sickness and it was not, as I recall, till 1903 when Güssou showed *Sclerotinia trifoliorum* to be responsible for at least a part of this sickness, that real light began to dawn. Later Amos in 1916 showed that nearly, if not quite all, clover sickness was due to this fungus or to a nematode. In 1919 I had the pleasure of meeting E. J. Russell at Rothamsted and he stated that clover sickness was no longer mysterious.

American agricultural literature too full of all sorts of guesses, but the only thi of value about these speculations is that th show the existence of trouble.

In the United States we can now say t the term "clover sickness" is a misnome clover failure is better.

No one who has read the agricultu literature of the past 40 years can doubt t there has been a decline in the acreage red clover but it is extremely difficult to p sent any exact figures to show the extent this decline. Data are poor and the b of them, those in the U.S. census, inclu all clovers—not red clover alone.

These data have been studied and a gra prepared showing the relation between acreage in all cereals, and that in clover al according to the census reports for 19 1910 and 1920, also the Timothy and clo acreage for 1910 and 1920, the earlier ports not including this item. The decline the acreage of clover from 1900 to 1910 v marked, amounting to about 42% for entire clover region. From 1910 to 19 there was some improvement but the acre

1920 was still not as large as that in 1900. hen it is remembered further that of late ars the use of both alsike and sweet clover s increased rapidly we can not avoid the nclusion that there is something wrong ith red clover. This fact is also brought t by a study of the relation between the re clover hay and all tame hay produced 1899, in 1909 and in 1919 as well as the percentage of all improved land that as in clover in those years. In each case ese figures show a decline in the acreage of over between 1900 and 1910 with some re- very by 1920.

We are certain therefore that the culture red clover has declined and we regard ch decline with concern since there is no own crop that, for the humid east, so well ls the dual role of hay producer and soil nprover. Clover culture has declined be- use of the frequent failure of red clover make a crop, and we understand by clover ilure the complete or partial loss of a stand red clover or the failure to secure a stand all after seeding.

The main causes of clover failure which wish to discuss briefly are:

1 Unsuitable soil conditions.
2 Unadapted or poor seed.
3 Diseases and insects.

SOIL CONDITIONS

Barring destructive insect and fungous seases, plants will thrive when soil, temper- ure and moisture conditions are favorable. mperature and moisture are beyond hu- an control in the clover belt but they are nerally favorable and by themselves rarely use a failure of clover. Young clover often ccumbs to an unusual drought, but even such cases well nourished plants will sur- ve when those less strong die.

A few years ago the speaker carried out e following experiment: Red clover seed as planted in two pots filled with a silt ay having a lime requirement as determined the Veitch method of 1300 lbs. CaO per re. Lime to neutrality was added to two her pots; calcium sulphate, at 400 lbs. r acre to a third set and lime and calcium lphate to a fourth. When the plants were about an inch high water was added to bring all pots to the same moisture content and the pots were then left to dry. The plants in the check pots and in those with calcium sulphate wilted several days before those in the pots with lime and when the plants were later washed out of the soil the root growth in the pots with lime was found to be several times as great as in the pots without lime.

Drainage is of course of the greatest importance. Red clover will not thrive on poorly drained soil.

Lime.

It is a common observation that clover does well on new land but that after a longer or shorter period, depending on the soil, clover ceases to do as well as formerly and finally fails almost or quite entirely. One of the chief causes of this failure is the lack of lime. I am not aware of any experimental work that can be cited as direct evidence for this statement, i.e. any work in which a given soil has been gradually deprived of lime by leaching and through crops, and the difference in the growth of clover noted. It has been shown however, that cultivated soils lose lime by leaching and through crops. In Illinois and Pennsylvania the loss from leaching was some 750 lbs. per acre per year. The classic work of the Pennsylvania Station has shown the relation between lime requirement and the growth of clover. It was also shown that the lime requirement of a field may vary and that while clover did well on the limed areas it did poorly or failed on those with a lime requirement of 1000 lbs. or more per acre. The Ohio station has an important series of fertilizer plots which have been carried on for many years at Wooster. Clover used to do well but gradually failed till in 1900 half of each of these fertilizer plots was limed. The result was immediate and striking, a good growth of clover being secured.

If time permitted results of this nature could be given from the work done by experiment stations in Kentucky, Illinois, Indiana, Michigan, Wisconsin and New York, all showing that on land depleted of lime by long cultivation, clover will not do well unless lime is added. In one experiment in

New York it was shown that on limed land there were but 1 or 2% of weeds with the clover while on similar but unlimed land the percentage varied from 21 to 49%.

Phosphorus.

Much of our eastern and middle west soil is short on phosphorus and some striking results have been secured especially by the Kentucky station showing that this element may be the limiting factor in clover growing. On one field where the clover was practically a failure on manured and limed land the addition of acid phosphate resulted in a ton of clover hay per acre. On another field the yield was increased from a little more than a ton to a ton and three-quarters. In Indiana the addition of phosphate to lime increased the yield by more than a ton. Here again cases could be multiplied to show that often lime alone will not do the work. Where available phosphorus is deficient it must be supplied. Potash has been found useful in some cases but only in a few eastern states has this element been found to be the limiting factor. Sulphur which has given such good results in Oregon has not proven important in the East.

This matter of soil condition may be summed up by saying that where lime, phosphorus and potash are present in sufficient quantities and are available, clover can be grown; where the soil is deficient in these elements they must be added.

Organic matter is important, especially so on those worn soils that tend to bake. On such soils the young clover is frequently killed by drought which it would be able to endure were more organic matter present to keep the soil loose and to hold moisture.

POOR OR UNADAPTED SEED

I shall not dwell on the subject of pure seed. This has been so long emphasized by seed analysts and others that we are quite familiar with the importance of pure seed. The matter of seed of strains adapted to the conditions has come into special prominence lately and the U. S. Department of Agriculture in co-operation with several State Experiment Stations has made some study of this. It has been found that seed from Europe and from South America is not ways the safest kind for the American fa to use. Seed from Italy has been found reliably winter hardy in many sections can only briefly summarize the reports the past three years by saying that in Indi Ohio, Pennsylvania, New York and New land more or less winter killing occurre plots seeded to Italian seed, while the pl from American seed suffered no injury. spring we have reports from New Eng and New York and W. Virginia indica very serious winter killing on the plots se to Italian seed. In N. Ohio and at Lan there was some winter killing, but no a serious degree, while in a test near G Rapids, Mich., the Italian plants winter-ki almost completely, while plants from Or seed alongside showed little injury. Spooner, Wis., the Italian plots suff badly while at Ashland the injury, th present, was less. At the Minnesota Sta Italian as well as all other foreign save Polish, Altaswede and Finnish, almost completely wiped out. With the ception of the trials in Minnesota, there nowhere any general killing out of pl grown from European or South Amer seed except Italian, though in some c notably at Spooner, Wis., some other E pean lots suffered more or less. Pennsylvania all European lots inc ing Italian came through last wi though in the winter of 1921-22 t was notable winter-killing on the Ita plots. This work will need to be carrie over a period of years before final con sions can be reached on seed from all s ces, but we are ready even now to say any American farmer living north of Ohio, in New York or in New Engl is running a serious risk of loss when seeds Italian red clover seed. In Maryl winter-killing does not often occur and Pennsylvania not always. Besides more less complete winter-killing, the acclimated seed is undesirable because t is frequently no second cutting. This been observed at Arlington Farm, in O Tennesee and Michigan. We hope to se more data on this point during the pre season.

The use of unadapted foreign seed is certainly one important factor in clover failure, but we have no data on which to make a guess at the extent of the damage.

DISEASES

We do not know how far diseases are responsible for clover failure. This was clearly the case in Tennessee some years ago and there is more or less evidence that some diseases as anthracnose, root rot and stem rot may be responsible in many cases. The data are however very imperfect. A case of disease causing total failure occurred on the Arlington farm last summer and showed that there may be a wide range of natural resistance to such a disease. The organism has not yet been determined. In this case the Tennessee strain selected for resistance to anthracnose showed 100% resistance to this disease (which may have been anthracnose) and the plants from S. Ohio seed also showed a high degree, but not 100% of resistance. Plants from Minnesota, Wisconsin and Idaho seed suffered materially while those from Oregon seed were practically wiped out. Of the foreign lots the Italian suffered nearly 100% loss, as did the N. German, but the loss in French and Chilean lots was less. Polish, Dutch, Danish and some English lots suffered severely. In this respect too there is doubt as to the adaptability of at least some foreign strains of red clover.

The breeding of new and desirable varieties of crops is an alluring field. I would like to distinguish here between selection and breeding, meaning by the latter the production of new varieties by crossing, with the subsequent fixing of the desired type. This, so far as I know, has never been done with red clover. Strains have been selected; in America such strains as Altaswede, developed in Alberta, and the Tennessee disease-resistant strain are examples. In Europe work of this sort has been going on consciously and subconsciously for many years and we have today several strains quite well marked physiologically but many of them not well marked morphologically. Lindhard distinguishes two main types, the early red and the late red, the chief difference between them being the date of blooming, though the flowers of the early are borne at about the same level because of strong growth of the lateral branches while in the late red these remain shorter. There is also a difference in fall growth, the early being inclined to make some stem growth the first season while the late red remains a rosette. Normally the early red yields two cuttings, the late only one.

However according to Witte the late Swedish reds may be again divided into early, medium and late and the earliest of these is a little later than the earliest of the early red type, but earlier than the later types of early red. There appear to be then several strains of single cut and of double cut differing from one another in earliness and in rapidity of growth.

In America (excluding such new types as Altaswede) there are two main types, June red and mammoth and, so far as our studies have gone there is little difference between seed grown in one part of the U. S. and in other parts. There is a difference however in hardiness and in disease resistance and it is to the natural selection exercised by the climatic and other conditions that we must look for the development of more satisfactory varieties. In sections of severe winters natural selection will force out the weaker and preserve the hardier. In the United States we have two general regions to consider—the North and the Atlantic seaboard and South—in the latter winter hardiness is not a prominent requirement, but resistance to disease and to summer heat is.

So far as possible the use of local seed is to be commended. Clover is perhaps not as sensitive to local conditions as corn, but there is no doubt that local conditions do impress themselves on clover if given time.

Meanwhile what we shall welcome is a hardy, disease-resistant strain, of double cut smooth red clover.

The Acidity of the Soil From the Viewpoint of it Concentration of Hydrogen-Ion.

By E. A. CARLETON

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The general nature of soil acidity is really just beginning to be understood. Previously there have been several conflicting views on the subject. There was one group of workers that denied the existence of true acids in the soil, accounting for the behaviour of a so-called acid soil as being due to adsorption. It has been demonstrated conclusively in the past five years that the acid condition of soils is due to true acids and these acids are at least indirectly the harmful agents. The evidence for this conclusion has become established through the application of modern physico-chemical methods for measuring the hydrogen-ion concentration.

We commonly think of an acid as being sour to the taste, turning blue litmus paper red, uniting with a base to form a salt and further as having replaceable hydrogen. From the standpoint of chemistry the replaceable hydrogen is the significant part of an acid and the source of hydrogen-ions.

According to the almost universally accepted electrolytic dissociation theory, acids and many other chemical compounds, under certain conditions, exhibit dissociation into electrically charged portions known as ions. These may consist of single atoms or groups of atoms. Only ionization connected with the dissolving of acids in water need concern us here. Acids differ widely in the extent to which they are dissociated or ionized in dilute aqueous solution. Among inorganic acids, many are almost completely, others only partially ionized. Of the organic acids a few are markedly, a considerable number slightly and many not appreciably ionized.

Water itself dissociates into hydrogen-ion, made up of positively charged hydrogen atoms, and hydroxyl-ion (OH-ion), made up of negatively charged hydroxyl groups. Acids yield hydrogen-ion and another ion consisting of the balance of their constituents; thus from hydrochloric acid, HCl, arise H and Cl$^-$, the latter being termed chlorid ion. Alkalies yield hydroxyl-ion and anot er consisting of the remainder of the co pound; in sodium hydroxide, NaOH, t ions are (OH)$^-$ and sodium-ion, Na$^+$.

The amount of hydrogen-ion in a solutio expressed as gram-equivalents per liter, often referred to as the hydrogen-ion conce tration. The hydrogen-ion concentration water is taken as the neutral point. Here t hydrogen-ion and the hydroxyl-ion are p sent in equal numbers—in other words equivalent amounts. The hydrogen-ion co centration of pure water has been calculat to be $1x10^{-7}$ or 0.000,000,1 grams per 1.0 grams: that is, in a ton of water 0.0018 gra are dissociated with the production of 0.00 grams of hydrogen-ion and 0.0017 grams hydroxyl-ion. There are a number of wa for stating the hydrogen-ion concentrati of solutions, but the one which is used mo employs the symbol pH. This symbol o curs so frequently in scientific literature th anyone connected with scientific work shou understand the meaning of the term. *pH minus the logarithm of the hydrogen-i concentration expressed in gram equivale per liter.* As the common logarithm of number is the power to which 10 must raised to equal the given number. it is ev dent that the logarithm of the hydrogen-i concentration in water is -7.000. Now p is this number (or the corresponding o for any solution) without the negative sig The pOH for water would also be 7.0 fo as has been stated above, the concentrati of the hydroxyl-ion is equal to the concentr tion of the hydrogen-ion. The product these two values is the dissociation consta for water. Expressed as concentration the two ions, this is $1x10^{-7}$ multiplied $1x10^{-7}=1x10^{-14}$, the last value being t dissociation constant. From this concepti it is possible to calculate the hydroxyl-i

concentration of an acid solution and the hydrogen-ion concentration of an alkaline solution. Thus, if the hydrogen-ion concentration is $1x10^{-2}$ (i.e. 0.01 normal) the hydroxyl-ion concentration will be $\frac{1 \times 10^{-14}}{1 \times 10^{-2}} = 1 \times 10^{-12}$ and the hydrogen-ion concentration of 0.001 normal alkaline solution (1×10^{-3}) will be $\frac{1 \times 10^{-14}}{1 \times 10^{-3}} = 1x10^{-11}$ The pH values of these solutions will be 2.0 and 11.0 respectively, while the pOH values would be 12.0 and 3.0 respectively. For convenience the values are stated only in relation to the hydrogen-ion concentration. With this in mind, let us restate the definition of an acid and an alkali for dilute aqueous solutions. A solution is acid when the hydrogen-ion is in greater concentration than the hydroxyl-ion and alkaline when the hydroxyl-ion predominates. In other words, acid solutions have pH less than 7.0, alkaline solutions pH greater than 7.0 and neutral solutions pH 7.0.

Acidity from this viewpoint deals only with the dissociated acid, and the amount of disociation varies with different acids, as has been stated. So-called strong acids are more highly dissociated than weak ones. For instance, a normal solution of hydrochloric acid and a normal solution of formic acid contain the same quantity of replaceable hydrogen (one gram per liter.) In the case of the first acid, 75% of the hydrogen is dissociated, giving a hydrogen-ion concentration of 0.75 grams per liter and a pH value of 0.12. In the case of formic acid, only 1% of the hydrogen is ionized and so the concentration of the hydrogen-ion is 0.01 grams per liter with a pH of 2.0. Lime requirement methods measure the total acid present ni the soil. Special methods must be used to determine the hydrogen-ion concentration.

There are two methods for measuring hydrogen-ion concentration either of which is applicable to soils. The first measures the difference in potential between the soil suspension and a standard electrode. This is the fundamental method and generally the more accurate. The second method depends on color differences of a mixture of the aqueous soil extract with an indicator, compared with carefully prepared standards of known hydrogen-ion concentration in which the same indicator has been placed. This procedure is much simpler and better in some respects for soil measurements than the electrometric method.

Both of these methods have been used by one investigator for determining the pH values of soils and good agreement obtained. Using both methods here at Macdonald College, we have secured very close checks. The soils measured were samples from different parts of the Province of Quebec. The pH values of these ranged from 4.8 to 7.6. Lime requirement measurements have also been made and show values up to ten tons of calcium carbonate as the lime required to neutralize the acidity of an acre of soil.

Technically four reasons may be suggested as accounting for the harmful effects of soil acidity: (1) unfavorable hydrogen-ion concentration; (2) presence of toxic substances; (3) improper nutrition arising from lack of calcium as a nutrient; (4) unfavorable biological conditions in the soil. Of the four the hydrogen-ion concentration is the most important because the other conditions depend largely upon it. Under natural conditions, it is this factor that determines what plants will grow. Several investigators have studied the problem from this viewpoint and find that there is close correlation between the soil reaction and the type of growth. Under field conditions the adaptability of the higher plants makes this factor more difficult to study, but it undoubtedly has some direct influence.

The indirect influence that a high hydrogen-ion concentration has on plant growth is due to the increased solubility of certain toxic materials in the soil. The element aluminum is the most important. The growth of plants in nutrient solutions where soluble aluminum compounds were present has proved that with certain plants this is an important consideration. There is evidence further to show that this element is important under field conditions. An application of acid phosphate on an acid soil often has as good effect on plant growth as an application of lime. The reason for this is that the dissolved aluminum is precipitated as insoluble aluminum phosphate.

The unfavorable biological conditions due to soil acidity have received much attention since the introduction of hydrogen-ion measurements into this problem. The greater sensitivity of the lower forms of plant growth to change in the conditions under which they grow, gives an advantage to this phase of the problem which is not realized in the case of the higher plants. By providing the optimum conditions for the more sensitive forms of plant life, the less sensitive ones are usually well provided for. Due to the inter-relation of bacterial activity and the growth of agricultural plants, it is very profitable to provide the best conditions for the former when the two coincide.

Lime requirement determinations of soils imply that the optimum soil reaction for plant growth is the neutral point; i.e., pH 7.0. In the majority of cases this is probably true, but there is at least one case where it does not hold. As progress is made in the study, it will undoubtedly be shown that by adjusting the soil reaction to certain pH values, certain advantages will be obtained that will make such practice of great economical value.

It has been found that when grown in soils of acidity pH 5.2 or more acid, potatoes were rarely affected by scab. Working along these lines, one investigator has shown by a convincing quantitative study how this disease may be checked on the Irish Cobbler potato. The soil at the start was at pH6.03, but treatment with 400 and 600 pounds of sulphur altered the acidity to pH5.2 and pH 5.07 respectively and the percentage of unsaleable tubers through scab decreased from 43 in the untreated soil to 9 and 7.5 respectively in the treated, the yield being approximately the same in all cases.

While the above illustrates one special advantage of an acid soil, the question nitrogen economy is usually the importa one. Under field conditions the high plants depend upon the activity of bacte and other organisms to prepare their fo for them as these forms of life have t power to decompose organic material to less complex form in which condition t organic nitrogen is available for the grow of higher plants. Some organisms also ha the power to fix nitrogen from the air a render it available for plant growth. the conditions upon which these process depend, the soil reaction is the most i portant. Azotobacter, a nitrogen fixing ganism, appears to be very sensitive to acidi and so is seldom found in soils of pH bel 6.0. The process of nitrification depen largely on the soil reaction. The results certain investigations would indicate th this process is carried only to the ammon stage in soils of pH 4.8 to 5.8, while for t formation of nitrate-nitrogen, a pH 6.8 necessary as the optimum soil reaction. Ro nodule bacteria of various legumes are i fluenced by soil acidity. The bacteria alfalfa seem to be the most sensitive a cannot tolerate an acidity greater than p 4.9 whereas those of lupine can withsta up to pH 3.2.

In conclusion, it may be said that t problem of soil acidity is a very importa one to agriculturists in humid regio The key to the situation is the practice applying lime. This does not mean, ho ever, liming to the limit as such a practi may result in soil depletion.

A soil analysis from the viewpoint of t hydrogen-ion concentration and the lime r quirement should be used to determine wh can be done to the best advantage of t crop to be grown.

A Survey of Weed Control and Investigation in Canada.

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For the purpose of a survey of what has been done in Canada, directly or indirectly, to the end of lessening the losses to agriculture from the prevalence of weeds, the information following has been brought together. It will be convenient to treat the federal and the several provincial activities separately.

I. Dominion of Canada.

With the establishment of the Dominion Experimental Farms system in 1887, an officer was appointed in the person of James Fletcher, who was already discharging some entomological duties for the government and whose new, combined office of Entomologist and Botanist included in its scope such attention to weed problems as would be necessary. There appears to have been nothing of note done earlier with weeds. A perusal of the Annual Reports of Dr. Fletcher from 1887 until his death in 1908 and his "Evidences before the House of Commons Select Standing Committee on Agriculture" during the same period shows frequent references to weeds, although it is apparent that entomological problems claimed the larger share of his altogether inadequate time. Besides carrying on a heavy correspondence with farmers throughout Canada on identification and eradication of weeds, his services were in demand at farmers' meetings, and, in the West especially, several extensive campaigns were conducted in company with western agricultural officials. The earliest of these covered the principal settled districts of Manitoba during the years 1896, 1897 and 1898, the advent of the Russian Thistle as well as of Tumbling Mustard and Perennial Sow Thistle in 1895 having made agitation against weeds opportune. In 1899 also, between June 19th and July 17th, Dr. Fletcher addressed a series of seventeen meetings in the old Territory of Assiniboia with weeds for his text and emphasizing summer-fallowing, use of weeders and harrows, seeding down, prevention of seeding, etc.,—all practices whose efficacy had been already well demonstrated by men like Angus McKay and S. A. Bedford, Superintendents respectively of the Indian Head and Brandon Experimental Farms.

These campaigns throughout the Prairie Provinces, and many other occasional addresses in all parts of Canada, were of the greatest value in their own time and circumstances. Even apart from his valuable services in the field of economic entomology, and his pioneer testing of native and other grasses, Fletcher's influence as an apostle of clean farming entitles him to a lasting place in the annals of Canadian agriculture. To his other efforts must also be added the preparation of timely articles and bulletins on various weeds which were compelling attention, as that on the Russian Thistle in 1894 and his more general descriptive bulletins: the first, C. E. F. Bul. 28 on Weeds appearing in 1897 and serving as one of the principal sources of material for numerous provincial publications on weeds until the publication in 1906 of the splendid "Farm Weeds of Canada," the text of which was also his work.

So far as research or experimental work with weeds is concerned, the showing for these early days is meagre, as indeed it may fairly be said to be even yet considering the advances made in other directions. As an example, however, it may be pointed out that mustard spraying with a 2 per cent. solution of copper sulphate was successfully experimented with by Fletcher and Shutt (Chemist of the Experimental Farms) in 1899 at a time when spraying for weeds was an innovation and, so far as Canada was

concerned, unknown. As an interesting sidelight on the situation in which Dr. Fletcher's work had its setting, it is worthy of note that he counted it worth his while to carry on, year after year, a set of plots demonstrating to skeptical visitors to the Central Experimental Farm that wheat does not turn to chess. Even in his Evidences before the House of Commons Committee, there are passages which show him elaborately defending his contention that such does not happen, and that his plots are a standing refutation of any such thing, observations and experiences of honorable members to the contrary, notwithstanding.

After the death of Dr. Fletcher in 1908, the separate Division of Botany was created with H. T. Güssow as Chief. The weed service offered to farmers was continued as before; but, whereas formerly the pressure of entomological problems made extended weed research impossible, so now the insistent urgency of plant pathological research with other economic botany left the situation much as before. Such work as has been accomplished is mostly to be found recorded in the Annual Reports. The most notable work published separately is Miss Fyles' comprehensive and beautifully illustrated "Principal Poisonous Plants of Canada," a volume of over 100 pages of text and 40 plates from drawings and photographs by the author.

Definite research upon the cause of animal maladies or poisoning due to weeds has been conducted in a few cases by the Health of Animals Branch of the Department of Agriculture. Since 1882, unsuccessful attempts had been made to learn the cause of what was known as the Pictou cattle disease from the county of that name in Nova Scotia where losses were severe. Fresh investigations begun in 1903, were so far successful by 1906 as to establish the responsibility of *Senecio Jacobaea*, an introduced Ragwort. The record of these experiments is to be found in a special report of W. H. Pethick published at their conclusion. In 1917, Hadwen and Bruce of the same Branch published their researches upon "The Poisoning of Horses by the Common Bracken," showing this fern to be the cause of a trouble in British Columbia known as "staggers," and detailing the course of the disease and remedi measures.

Of all possible work against weeds, pr bably the most amenable to exact and sy tematic handling is that for the preventi of weed seed dissemination by the regulati of the seed trade. Accordingly, about 1902, beginning was made in this direction by t appointment of Geo. H. Clark to the Ag culture and Dairying Commissioner's Bran as Chief of a Seed Division. Investigatio and analyses of seed samples commenced once, prepared the way for the introducti in 1903 by the Hon. Sydney A. Fisher, Mi ister of Agriculture, of legislation to pr vide for the inspection of seed in Canad Before becoming operative as the Seed Co trol Act of 1905, it was reprinted and d tributed widely "in order that seed growe and seed merchants may have an opportuni to examine more closely into its provisio and point out to Parliament difficulties whi may arise that would seriously interfere wi the carrying on of their business." It mu be remembered that it was "only during r cent years that legislative measures ha been resorted to in regulating the trade agricultural seeds on the American conti ent"; although such regulation had becom general in Europe during the quarter-centu previous.

Since coming into force, this A has been administered by the then separatel organized Seed Branch, still under the dire tion of Mr. Clark; and, as subsequent amended and amplified by Orders in Cou cil, has exercised a very effective control the spread of noxious weeds through co merce. A staff of inspectors in the vario Provinces is actively engaged in the e forcement of its provisions and in the educ tional propaganda which is held to be all-important adjunct. Seed laboratories Calgary and Winnipeg relieve the Ottaw laboratory of the heavy analytical work the West, and it has been found necessa recently still further to extend organizatio not entirely, however, to care for the see impurity phase of the laboratory work.

Besides its routine analytical work, t Seed Branch has carried out numerous spe ial investigations. The first work done determine what weed seeds were common

ound in Timothy, Alsike, and Red Clover eeds was published in 1904 as Bul. 16, New Series, of the Agriculture and Dairying Branch. Bul. S-7, 1912, on Wild Oats and False Wild Oats records an experimental tudy by Norman Criddle, from which the onclusion is drawn that False Wild Oats re not likely to become a serious pest. The levator screenings menace, both as regards listribution of noxious weed seeds and as egards the use of such screenings with the ontained weed seeds, in feeding stuffs, has been closely investigated, and recommendations have been made which have resulted in better disposal of the dockage from grain. Other results of original investigation have been embodied in various publications on weeds and weed seeds, the most of which have drawn largely for their general matter on "Farm Weeds" already mentioned. This arge and finely-illustrated work appeared s a Seed Branch publication in 1906, and was distributed widely to schools and farmers. A second edition re-arranged and enlarged to 192 pages with 76 colored plates rom drawings by Norman Criddle, as also n the first edition, was issued in 1909 at nominal charge of $1.00.

One other piece of investigation which is ntitled to notice here is the weed survey which formed a part of the Agricultural Survey conducted throughout Canada by the Committee on Lands of the Commission of Conservation, for a number of years beginning in 1911. About three dozen weeds were reported on as to their presence, serusness, etc., on the hundreds of representative farms visited, thus furnishing much he best information available on the recent istribution of some of our worst weeds.

In leaving that part of our subject relating to Federal activities, it is only just to ay that much of the best work against weeds s done by those agencies of various sorts, which make for balanced or mixed farming as distinguished from exclusive grain farming), thoroughness in tillage and cultural ractises generally,—in short, good farming. Weed control is pre-eminently a field husandry problem, and the "weed man" merea specialist who has to be called in, like physician, when all is not well.

II. Ontario.

In Ontario, weed propaganda has for the greater part emanated from the Ontario Agricultural College, Guelph. An Agricultural Commission, appointed about 1880 to make a comprehensive study of conditions in the Province, included weeds in the scope of its inquiry; but, almost as early, Prof. Panton, Instructor in the Natural Sciences at the young College, was giving attention to the subject. His O. A. C. Bul. 10, a small-paged, three-page article entitled simply "Weeds" was the first of a long series put out by the College from that date, 1887, to the present. His second bulletin was on that perennial topic of dispute, "Chess"; and the third "Weeds of Ontario," 1893, compressed into seven pages the gist of over 1,000 replies to an inquiry as to the ten worst weeds locally in Ontario. "Impurities in Clover Seeds" in 1894 was based on some early seed testing, such as was carried on even before Seed Branch days, at the College and the Central Experimental Farm, Ottawa. A somewhat larger bulletin than any hitherto was prepared by Messrs. Shaw and Zavitz of the farm department of the College in 1892 and served as a practical handbook for farmers for some years. Meanwhile, information was being assembled by a committee of the ex-student organization of the College, the Ontario Agricultural and Experimental Union, which assumed form in 1900 as a fully illustrated bulletin of 80 pages, with the title "Some Common Ontario Weeds," immediate author, F. C. Harrison, and artist, Norman Ross. Subsequent editions, brought up to date by the later botanists of the College, have grown to almost twice the size.

Quite recently a useful "Guide to the Poisonous Plants and Weed Seeds of Canada and the Northern United States" by Professors Thompson and Sifton of the University of Toronto, has been published by the University of Toronto Press. This work is compact in 169 pages, including 40 mostly full-page illustrations from photographs and drawings; the arrangement of the matter according to the source of the plants in the animal's feed, is original and convenient; and the matter itself, especially in the section on plants dangerous in ground feeds, contains much information not found in

most text-books. It is well designed for its purpose of an inexpensive reference book for students and all who have to do with cases of plant poisoning, whether of animals or man.

Experiments and demonstrations in the use of chemicals against weeds have been undertaken at various times. M. W. Doherty, in 1901, made a three-weeks' itinerary of Eastern Ontario, giving spraying demonstrations wtih Copper Sulphate on infested farms and addressing the assembled farmers. The success of the applications and further work in 1902, under varying conditions and stages of development, is given in the Annual Reports of the College for those years. Another report in 1904 presents the results of a test at the College of Copper Sulphate on 28 species of weeds belonging to twelve botanical families, which was sufficiently successful for recommendation on Wild Mustard only. More recently, J. E. Howitt has experimented with Iron Sulphate to destroy Dandelions on lawns with considerable success, and with other preparations on various weeds with less success. A rather far-reaching line of experimental work in weed eradication was instituted by Howitt in 1912, and has been conducted as a co-operative project with farmers on their farms, through the medium of the Ontario Agricultural and Experimental Union. These experiments to date have comprised eight of the worst weeds of the Province and have resulted in placing some of the commonly recommended methods of eradication on a basis of experimental proof—a standing enjoyed by surprisingly few of even the most successfully-employed methods.

Legislation against weeds in Ontario dates back to 1887 at least, an "Act to Prevent the Spread of Noxious Weeds, and Diseases Affecting Fruit Trees" being on the statutes at that time. The present Act appearing in the Revised Statutes of 1914, while susceptible of improvement, chiefly requires only to be better enforced to meet most of the needs of the case. As a matter of fact, an investigation into its effectiveness made a few years ago disclosed that "out of the 600 townships in Ontario only 92 were making any effort to enforce the Act. Only in 49 had inspectors been appointed. In regard to the work of the inspectors, 17 tow ships reported the work of the inspectors satisfactory; 14 reported that the work w partially satisfactory. Out of the 600 tow ships of the Province, only 15 reported th this Act was successfully enforced; 72 th it was partially enforced; and the remaind reported that it was practically a 'dead le ter'." The prevailing mixed-farming pra tises of Ontario serve to prevent weeds ge erally from getting entirely out of bounds but this very possibility of relative freedo from noxious weeds is so much the great reason for more energetic and thorou handling of the situation.

III. The Prairie Provinces.

Weed work in the three Prairie Provinc has much in common. Both in Manitob and in the former Territories, legislation f the control of weeds was enacted in, about, 1898: some municipalities like India Head and Qu'Appelle having had local o dinances even in advance of the wider enac ments. The three Provinces as now constitu ed have brought their early Acts by degre to their present form, the most complete an workable in Canada. In each Province, th provisions for inspection and the oversigh and direction of inspection are being we carried out. In Manitoba, inspectors and Chief Inspector were provided from th earliest days of the Act; then for six yea a Weeds Commission functioned until, o the latest revision of the Act in April, 192 a Weeds Administrator took the place of th Commission in directing the inspection. Thi office was filled by the retention of Dr. Bed ford, the efficient Chairman of the late Com mission, who is devoting himself to perfec ing still further Manitoba's excellent weed fighting organization. The inspectors in th various municipalities are not only charge with enforcing the provisions of the Act b also make detailed reports on the extent an spread of weeds, so that it has been possibl to prepare an almost complete set of mun cipal weed maps showing the exact rang even to quarter-sections, of the worst wee pests.

In the Territories, T. N. Willing was th first Chief Weed Inspector, his excelle work covering the period from 1898 unt 1909 (then in Saskatchewan). The more rece

developments in Saskatchewan and Alberta are somewhat in keeping with those of Manitoba. Each Province has aimed to educate as well as legislate and has had its own descriptive bulletins prepared orginally by Dr. Fletcher, and later by Mr. Willing and his successors in the two newer Provinces and by officers of the Manitoba Agricultural College in the older Province. The first of these bulletins appeared in the Territories in 1898, and, in Manitoba, what was substantially the same work, in 1899. Since then, a "Lessons on Weeds," written in 1918 by V. W. Jackson of Manitoba Agricultural College and designed for use in schools as well as by farmers, is, perhaps, the most distinctive and noteworthy publication. A new edition, incorporating valuable new information, has just been prepared.

Other means which have been employed to arouse and maintain interest in the very serious weed problem of the West, are contests in the maintenance of an efficient, bare summer-fallow, and, in 1921, a "Weed Special" run over the C.P.R. lines in the three Provinces from January to March. The Railway provided a train which included a demonstration and two lectures cars, and this was manned by speakers from the three Departments of Agriculture, the Agricultural Colleges, and the Dominion Department of Agriculture. In the six weeks' tour of the West, over seventy points were visited, and over 14,000 people were addressed.

Still further to maintain interest and coordinate effort, conferences of, and short courses for, weed inspectors are held from time to time. Opportunities to bring farmer and inspector together to discuss weed problems are made use of; as it is felt that only by the most thorough-going measures on the part of both is there hope of coping successfully with the weed menace.

IV. British Columbia.

The Pacific Coast Province, not having so acute a weed problem as the grain-growing Prairie Provinces, has little in comparison to report of activities for the suppression of weeds. A Noxious Weed Act has been on the Statutes for some years, and a new Act in 1915 repealing the older one shows that attention is being paid to perfecting legislative control. Several small bulletins on weeds and poisonous plants have been issued by the Department of Agriculture. The principal one on "Noxious Weeds" is now undergoing extensive revision by the Agronomy Department of the Provincial University.

V. Quebec and the Maritime Provinces

In the East, as in British Columbia, weeds, though not negligible, have not drawn to themselves so much attention as in the Prairie West or as even in Ontario. Quebec has had at least one considerable publication on its "Weeds" prepared by C. E. Dalaire in 1904; New Brunswick, one by D. W. Hamilton some years ago; and Prince Edward Island, one by W. Lochhead of Macdonald College, Que., and J. A. Clark of the Experimental Station, Charlottetown, P.E.I., in 1906. Of other propaganda, the New Brunswick Department of Agriculture carried out some demonstrations in mustard spraying a few years ago, and, in each of these Provinces, a certain amount of educational work through platform and press has been achieved. In Nova Scotia and Prince Edward Island particularly, the Ragwort disease of cattle was a live question for discussion at one time, in which Father Burke, then of the Island, was an active participant. The experimental work instituted by the Health of Animals Branch in 1903 finally removed the matter from the field of controversy.

Concerning legislation, it would appear that in most of the East a Weed Act would be only a dead letter for lack of a sufficiently compelling incentive for its enforcement, such as is found in the West; and, therefore, in some of the Provinces, such legislation is lacking. New Brunswick is without any Weed Act. In Nova Scotia "the only legislation in respect to weeds is found under the Municipal Act," the councils having power to make By-laws for "preventing the growth of thistles and other noxious weeds." "Under the provisions of this Act, certain municipalities have made it compulsory to destroy certain noxious weeds and especially the *Senecio Jacobaea* along roadsides." In Prince Edward Island, a Noxious Weed Act passed in 1909 "was administered by road overseers and supervisors; but a new Road Act did

away with both these offices so that the Weed Act is now inoperative." The Revised Statutes of Quebec, 1909, now in force, contain a provision to the effect that "any person may by special notice require any owner, etc. ....to cut.....daisies..... and all other noxious weeds"; and provides penalties for neglect. Clean farming in this Province is encouraged, however, in other ways as well; as, for instance, in the judging of farms entered for qualification for the unique Order of Agricultural Merit, an account of which was published in the Agricultural Gazette of Canada, Vol. 8, No. 6.

Doubtless, somewhere in this ramblin survey of Canadian weed history, even and work of the first consequenc have escaped us. It would b impossible, of course, to enumerate all c the really valuable contributions to progres of a less outstanding character. For muc of what has been given, I am deeply indeb ed to officials in the various Colleges an Departments of Agriculture; and for th remainder, to the records left in their man publications, only some of which have recei ed direct recognition in this account.

Book Reviews.

The Story of the Maize Plant.

By PAUL WEATHERWAX,

Assoc. Prof. of Botany, Indiana University.

(University of Chicago Press, 225 P.P.)

This little book will be found especially useful to the student who desires specific and concise information regarding the maize plant. Hitherto one has been obliged to consider a large mass of material in order to obtain the information he seeks. Almost every conceivable aspect of the plant has been considered. Beginning with a brief account of the origin and geographical distribution of maize the author passes to an interesting and well illustrated description of the structure and germination of the seed and the anatomy and physiology of the stem, leaf and roots. Then there follows a concise outline of approved modern methods of planting, tillage and harvesting.

The concluding chapters, all replete with excellent illustrations, deal in a particularly pleasing manner and in considerable deta with the peculiar and interesting inflorescenc of the maize plant, its pollination, and th structure of the ear and kernel. An inte esting account also is included of the here ity of maize and the methods of breedin employed in its improvement. Finally an e tertaining description is given of the plac of maize in aboriginal as well as in moder American life.

As a text book in schools, the book shoul be exceedingly valuable, not only because c the manner in which a most voluminous li erature has been reviewed, but because c the fact that the Bibliography cited const tutes a valuable index to the best literatu on the subject.

L. H. N

La Convention de Saskatoon.*

La troisième Convention annuelle de la ociété des agronomes canadiens tint ses sises à l'Université de Saskatoon du 20 au 3 juin. Elle fut précédée par l'Assemblée nuelle de l'Association canadienne des oducteurs de semence et suivie par une nférence des régisseurs de fermes expéri-entales de l'Ouest.

Cette réunion de l'élite des agriculteurs chniciens et praticiens, à un moment de ise aussi aiguë que celle que traverse pré-ntement l'agriculture canadienne, méritait u public plus d'attention qu'elle semble en oir obtenu et nous croyons qu'il serait bon étudier sérieusement les moyens suggérés our favoriser le développement de notre dustrie fondamentale et pour l'aider à rtir de l'impasse où elle se débat.

Comme aux conventions précédentes, les ongressistes montrèrent un enthousiasme ujours croissant et une grande confiance en avenir de leur association professionnelle.

Malheureusement la température fut fort éfavorable, et une pluie continue entrava la rie des amusements organisés pour divertir s congressistes et pour les reposer du trav-l qu'ils accomplirent au cours des nom-reuses sessions du Congrès.

Le professeur Shaw avait préparé une agnifique exhibition du betail de la ferme e l'Université et les délégués purent admirer s excellents sujets qui composaient la par-de.

Une série de conférences organisée par le épartment de l'Agriculture fédéral furent onnées par des autorités agricoles dont le r. F. J. Alway, le Dr. H. K. Hayes, le Dr. J. Pieters et le Dr. W. W. Swanson qui aitèrent respectivement des sols, des cer-les, des récoltes fourragères, de sujets con-rnant l'économie rurale.

La Convention fut présidée par le profes-ur H. Barton du Collège Macdonald, lequel t président de la Société des agronomes nadiens pour l'année courante. M. Fred Grindley fut nommé de nouveau secrétaire énéral de la Société. Les membres appréc-rent hautement les services qu'il rendit à l'Association au cours des années précédentes et louèrent l'initiative dont il fit preuve pour rendre la position financière de la Société stable.

Rapports des Comités en Fonction.

Les présidents des différents Comités nommés à la convention de l'an dernier firent leurs rapports respectifs. M. A. Leitch, présenta le rapport du Comité de l'enseignement commercial agricole, M. G. G. Moe, celui du Comité des études universitaires agricoles, le Dr. L. S. Klinck celui du Comité des programmes d'enseignement.

Les représentants des diverses branches locales présentèrent aussi leurs rapports.

L'on adopta quelques amendments aux règlements de l'Association dont l'un a pour objet la cotisation des membres et sa répartition entre le bureau central et les sections locales. Cette cotisation sera à l'avenir de $10.00 pour la première année et de $6.00 pour les années subséquentes. Les branches locales recevront $2.00 de chaque cotisation de $10.00 et $1.00 de chaque cotisation de $6.00.

Titres Honorifiques.

La Société conféra le titre de "Compagnon" au Dr. James W. Robertson d'Ottawa. Le nom du Dr. Robertson est intimement lié au développement de l'agriculture au Canada. Il occupa successivement les importants postes suivants: commissaire de l'industrie laitière au Canada, principal du Collège Macdonald, président de la Division des Terres à la Commission de Conservation, président de l'Association Canadienne des producteurs de semences, président de la Commission royale de la formation industrielle et de l'enseignement technique, etc. Le Dr. Robertson dirige actuellement le travail de l'Association des Boy Scouts et de l'Association de la Croix rouge canadienne, étant respectivement commissaire en chef et président de chacune de ces deux organisations. Le Dr. Robertson

* Note de la Rédaction:—M. Georges Bouchard, secrétaire de la partie française de la revue, étant en France, M. A. Gosselin a eu l'obligeance de préparer le rapport ci-dessus.

est le troisième membre de la Société des agronomes canadiens qui reçoit le titre de "Compagnon". Ce titre avait d'abord été conféré au Dr. L. S. Klinck et au Dr. C. E. Saunders.

La Convention de 1924.

La prochaine Convention annuelle sera tenue en 1924 au Collège d'Agriculture de Guelph, Ont. Heureuse coïncidence, cette Convention aura lieu en même temps que les fêtes du 50ème anniversaire de la fondation du Collège de Guelph, en 1874.

Boursiers de la C.S.T.A.

Un comité spécial fut appointé pour considérer les qualifications des aspirants aux bourses distribuées par la C.S.T.A.

Actuellement deux bourses sont disponibles, dont l'une offerte par les annonceurs de la revue, et l'autre par le Ministère de l'Agriculture de Québec, à l'un des membres résidant dans cette province. Chaque bourse a une valeur de $600.00.

La première de ces bourses fut accordée à M. W. F. Hanna de l'Université d'Alberta. M. Hanna naquit en 1892 à Musquodoboit, comté d'Halifax, N.E., où il fit ses études primaires et de high school. Il entra à l'Université de Dalhousie en 1910 et y obtint son titre de B. A. en 1914. Il servit ensuite dans l'armée canadienne en Europe, de 1914 à 1918 et il fut blessé. Il se maria à Paris à la fin de la guerre, puis revint au Canada. Après avoir suivi le cours d'agriculture à l'Université d'Alberta, il obtint le dégré de B.S.A. en 1922 et gagna la médaille d'or du gouverneur général. Après s'être livre à des travaux de recherches sous la direction du Mr. Newton de l'Université d'Alberta, il obtint le degré de M.Sc. en Agriculture en 1923.

Il étudiera maintenant la mycologie et physiologie des plantes à l'Université Manitoba.

La bourse donnée par le Ministère l'Agriculture de Quebec n'a pas encore accordée et le terme pour les demandes prolongéra jusqu'au 31 juillet 1923.

Rapport du Secrétaire-Tresorier Génér

Le secrétaire général, M. Fred. H. Grii ley présenta la rapport couvrant les opé tions de la société durant les douze derni mois. Cet intéressant rapport démontra a congressistes le progrès constant, la stabil financière et l'augmentation des membres la Société qui atteignent maintenant le no bre de 662.

Ce rapport contient de précieux renseig ments sur les différentes activités de l'Asso tion.

Discourses du Président Sortant de Charge.

M. J. B. Reynolds, président du Colli de Guelph, Ont. définit le but de la soci des agronomes; après avoir indiqué le r important qu'est appelée à jouer cette asso tion, il s'efforça de démontrer que le relè ment de l'agriculture au pays n'était pas seu ment une question d'intérêt professionn mais aussi une question d'interêt public national.

La plupart des rapports et des disco faits à cette Convention seront publiés anglais dans la revue et, si les circonstan le permettent, on en publiera aussi un résu en français.

Concerning the C.S.T.A.

APPLICATIONS FOR MEMBERSHIP

(Accepted since May 1, 1923)

SSOCIATE MEMBERS:

Graham Anderson, Dept. of Agriculture, Regina, Sask.

Donald Douglas, Dept. of Agriculture, Edmonton, Alta.

M. L. Freng, Lethbridge, Alta.

W. B. Gornall, Dominion Fruit Branch, Regina, Sask.

Alex. McPherson, Dominion Seed Branch, Saskatoon, Sask.

EGULAR MEMBERS:

R. K. Baker, (Manitoba, 1900, B.A.), University of Saskatchewan, Saskatoon.

C. Barry (British Columbia, 1923, B.S.A.) Vancouver, B.C.

J. Begin, (*) Loretteville, P.Q.

. S. Benson, (Saskatchewan, 1921, B.S.A.), University of Saskatchewan, Saskatoon.

Louis Berubé, (*), Dept. of Agriculture, Quebec, P.Q.

G. E. W. Clarke, (British Columbia, 1922, B.S.A.), Vancouver, B.C.

. W. Clay (McGill, 1922, B.S.A.), Charlottetown, P.E.I.

K. Finlayson, (Saskatchewan, 1923, B.S.A.), Dept. of Agriculture, Regina, Sask.

E. C. Hallman (Toronto, 1902, B.S.A.), Acadia Valley, Alta.

E. K. Hampson, (Toronto, 1915, B.S.A.), Agricultural School, Kemptville, Ont.

A. C. Heise, (Manitoba, 1918, B. S. A.), Fort William, Ont.

. J. Hooper, (Saskatchewan, 1921, B.S.A.), Dept. of Agriculture, Regina, Sask.

Adrien Morin, (*), Dept. of Agriculture, Quebec, P.Q.

O. McConkey, (Toronto, 1917, B.S.A., Illinois, 1922, M.S.), O.A.C., Guelph, Ont.

A. F. McKean, (Saskatchewan, 1923, B.S.A.), Saskatoon, Sask.

H. R. McLarty, (McMaster, 1920, M.A.), Summerland, B.C.

A. E. Palmer, (Utah, 1917, B.S.), Lethbridge, Alta.

W. T. Perry (McGill, 1921, B.S.A.) Moncton, N.B.

H. J. Pugsley, (Ont. Vet. Coll., 1899, V.S.), Fredericton, N.B.

Fraser Ross, (Toronto, 1922, B.S.A.), Fort William, Ont.

F. S. Thomas, (Toronto, 1922, B.S.A.), Port Arthur, Ont.

G. Whiteside, (Toronto, 1922, B.S.A.), O.A.C., Guelph, Ont.

*Details regarding these applicants, as to University, year and degree, have not been received.

NOTES.

D. E. Lothian (Macdonald 13) has been appointed to the staff of the Canadian Immigration Department, with headquarters at Aberdeen, Scotland. He was formerly with the Soldier Settlement Board in British Columbia.

C. E. Bain, formerly Markets Representative of the Dominion Live Stock Branch at Calgary, has been transferred to Winnipeg. He has been Secretary of the C.S.T.A. in Alberta for the past two years.

R. Innes (Macdonald '11) has just returned to Ottawa from a six months' business trip to India, for the Soldier Settlement Board of Canada. Approximately 150 certificates were issued by Lt.-Col. Innes to demobilized British officers who wished to take up farming in Canada.

Lionel Stevenson (O.A.C. '12) has been appointed Director of Extension Service at the O.A.C. For the past two years Mr. Stevenson has been Secretary of the Department of Agriculture at Toronto, and was formerly Superintendent of the Experimental Station at Sidney, B.C.

Stanley Wood (O.A.C. '23) has been appointed District Representative for the Counties of Albert, Westmoreland and Kent, in New Brunswick, with headquarters at Moncton. Mr. J. H. King (Macdonald '15) who previously occupied this position, is now Manager of the Farmers' Co-operative Creamery at Moncton.

J. E. Howitt (O.A.C. '05), Professor of Botany at the Ontario Agricultural College, has been appointed as representative of the C.S.T.A. on the Council of the American Association for the Advancement of Science.

R. A. Derick (Macdonald '20) has received his M.Sc. in the Department of Botany at McGill University. He has returned to the University of British Columbia to resume his duties in the Department of Agronomy.

R. H. Helmer has resigned his position as Superintendent of the Dominion Experimental Farm at Summerland, B.C., to accept an executive position on the estates of Major Goldman at Nicola, B.C. Mr. Helmer is at present in England but is expected to take over his new duties in October.

H. M. McElroy (O.A.C. '13) Superintendent of the Industrial Farm at Fort William is undertaking the organization of a Northern Ontario Branch of the C.S.T.A. He expects to hold an organizing meeting during the coming winter.

J. C. Noble (Manitoba '11) has been appointed District Seed Inspector under the Dominion Seed Branch, at Regina, Sask. He was formerly on the staff of the Manitoba Agricultural College.

L. H. Newman (O.A.C. '03) is visiting all of the Dominion Experimental Farms and Stations during the summer months, in his new capacity as Dominion Cerealist.

E. A. Lloyd (Saskatchewan, '17), Assoc Professor of Poultry Husbandry at the U versity of British Columbia, is taking gr uate work at Cornell University.

L. C. McOuat (Macdonald '15), Ba Specialist in the Dominion Live Stock Bran left for England on July 27th, on offi business.

The American Association of Instruct and Investigators in Poultry h hold its annual meeting at the Chat Laurier, Ottawa, Aug. 21-24. About three hu dred members are expected to attend.

NOVA SCOTIA BRANCH

The summer meeting of the Nova Sco Branch, C.S.T.A., is being held on Aug 20th and 21st. In addition to business me ings, visits will be made to the Dominion perimental Farms at Kentville and Nappan

NEW BRUNSWICK BRANCH

The New Brunswick Branch, C.S.T.A., w hold a summer meeting at the Experimen Farm, Fredericton, on August 13th.

WESTERN ONTARIO—100 MEMBERS

The Western Ontario local is the fi branch of the C.S.T.A. to attain a memb ship of 100. Eastern Ontario is a cl second with a membership of 95.

BUREAU OF RECORDS

In his annual report at the Saskatoon C vention, the General Secretary pointed that employing institutions were not usi the C.S.T.A. Bureau of Records to any preciable extent, and that steps would ha to be taken by the Society if the Bureau w to function in the manner intended at time of its establishment. The informati now on file in the Bureau should be ma available to every member of the Society a to any others to whom such informati would be of value for reference purposes

The most desirable way in which to develop the usefulness of the Bureau would be to publish a loose-leaf "Who's Who in the C.S.T.A." in which all members would be listed under various headings (Botanists, Entomologists, etc.) and in which full information regarding training, experience, etc. would be given. No reference should be made to salaries. Such a volume could be revised from time to time.

Some expense would be involved, but the service rendered to the members and to the profession would be considerable and should justify the cost. The matter is now receiving consideration, and if the idea develops, the proposed volume would be published about January, 1924.

In the meantime, members who have not yet returned the questionnaire sent to them several months ago, should do so at once, and any whose positions have changed should notify the General Secretary of any additions that should be made to their record. Members who have not received any questionnaire should apply for it.

There are many arguments in favour of publishing such a volume as is contemplated, and a number of useful features can be embodied in it. The two main arguments against it are (1) that it is limited to members of the Society and consequently will not include all who are engaged in professional agriculture, and (2) that in some divisions of agricultural science similar information is already available. If however, proper care is given in the matter of compilation and presentation, a volume can be produced that will be of very great interest and value to those who receive it, even though it is necessarily limited in its field and may, in a few instances, be a duplication. It is certain that no similar material has ever appeared in printed form.

MATERIAL FOR PUBLICATION

The next issue of *Scientific Agriculture* will commence a new volume, and the attention of members is again directed to the importance of using their official organ for the publication of articles on agricultural research, experimentation, education, marketing, etc. During the past two years it has been very difficult to keep the quality of the magazine up to a standard that would be creditable to the Society, and only the most complete co-operation and support on the part of the membership can maintain that standard. Members are therefore urged to give this support at every possible opportunity, in order to prevent any possible suspension of publication, or a decrease in the size of the magazine.

TEXT BOOK CLUB

The attention of members is also directed to the Text Book Club, established two years ago in the office of the General Secretary. Members can save money by ordering agricultural books through their own office. A discount of 20 per cent. is allowed on practically all standard volumes, and the Society pays all charges for postage, insurance, etc. Sixteen publishing houses are already co-operating in this arrangement.

SUPPORT THE ADVERTISERS

During the past two years the entire cost of publishing *Scientific Agriculture* has been borne by the advertisers. Without their support an official organ would be impossible. These firms and products, selected with care and endorsed as absolutely reliable, should be given the support of every member. In your contact with farmers and students, remember that you are in a position to render a distinct sevice to your advertisers.

The scholarship recently awarded by the Society was made possible by the co-operation of our advertisers. As an organization, we should stand solidly behind them.

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